AD NUMBER

AD366703

CLASSIFICATION CHANGES

TO: unclassified

FROM: confidential

LIMITATION CHANGES

TO:

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FROM:

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AUTHORITY

DSWA ltr., 10 Apr 97; DSWA ltr., 10 Apr 97

XRD
16

(14) XRD-16

CONFIDENTIAL

CONFIDENTIAL
Security Information

(9) BUREAU OF SHIPS GROUP

TECHNICAL INSPECTION REPORT.

[redacted]

CONFIDENTIAL
Security Information

Classification (Cancelled) (Changed to) (Confidential)
By Authority of JOINT CHIEFS OF STAFF JCS 1795/36 DATED 15 APRIL 1949
By John H. Veyette Date 23 SEP 1958

(6) OPERATION CROSSROADS.

U.S.S. ARKANSAS (BB33).

TEST ABLE.

VOLUME 1 [redacted] (8) U.

366703

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Defense Atomic Support Agency
Washington, D. C. 20301

(11) 1947

(12) 166p.

OPERATION CROSSROADS

DDC

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NOV 2 1965

DIRECTOR OF SHIP MATERIAL

[redacted]

JOINT TASK FORCE ONE

GROUP-4
Downgraded at 12 year intervals;
Not automatically declassified.
JAN 1965

REG. NO. 53

[redacted]

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BUREAU OF SHIPS GROUP

TECHNICAL INSPECTION REPORT

APPROVED:

F.X. Forest,
Captain, U.S.N.

SECRET

USS ARKANSAS (BB33)

Page 1 of 164 Pages

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TABLE OF CONTENTS

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U.S.S. ARKANSAS (BB 33)

SHIP CHARACTERISTICS

Building Yard: New York Shipbuilding Corporation.

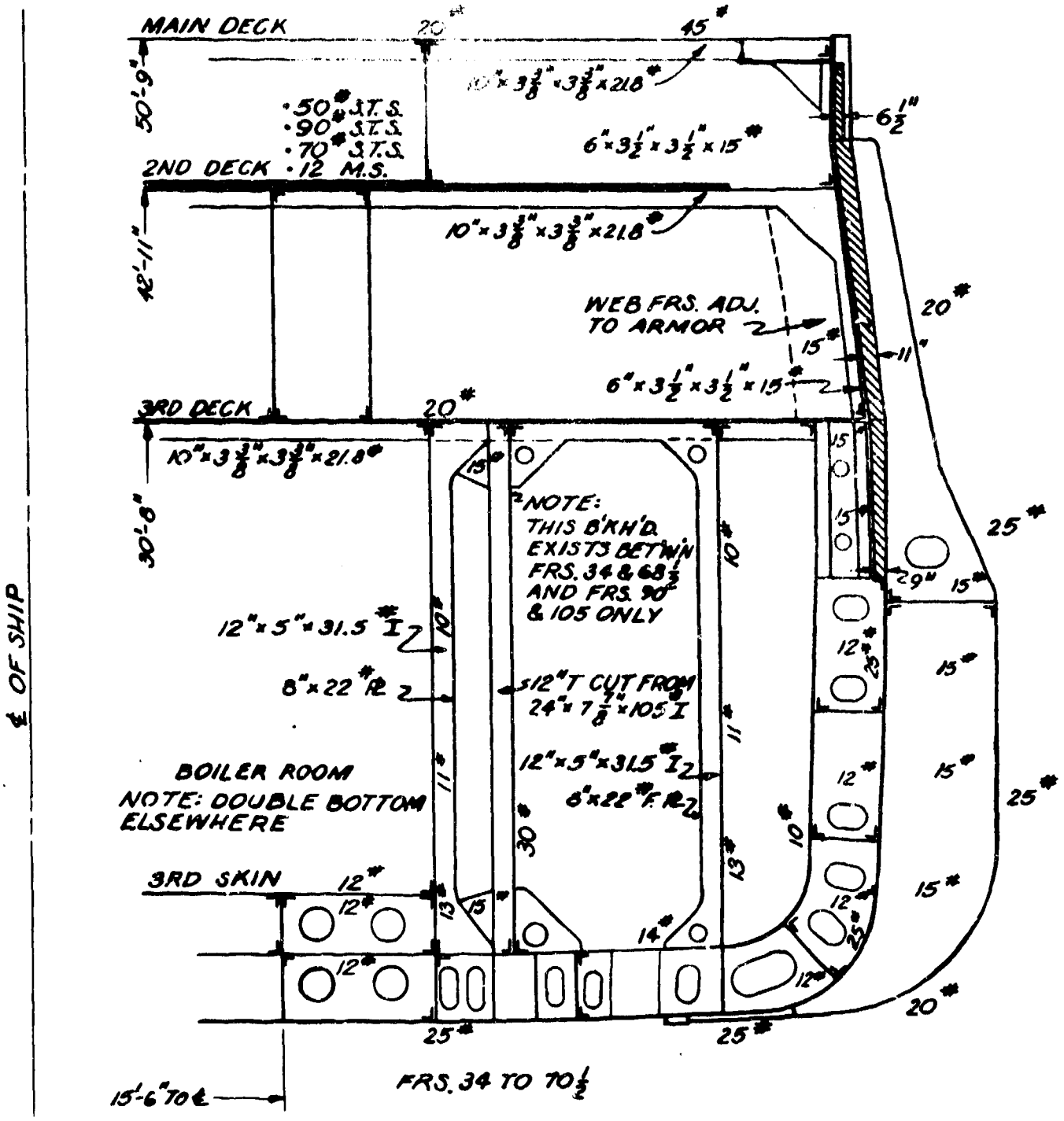
Commissioned: 17 September 1912.

HULL

Length Overall: 562 feet 0 inches.
Length on Waterline: 554 feet 0 inches.
Beam (extreme): 106 feet 1 inch.
Depth (molded at side, to main deck, frame 69 3/4): 48 feet 8 1/4 inches.
Drafts at time of test: Fwd: 29 feet 5 inches.
Aft. 30 feet 6 inches.
Standard Displacement: 26,100 tons.
Displacement at time of test: 30,600 tons.

MAIN PROPULSION PLANT

Main Engines: Parsons Turbines,
1. Port and Starboard outboard shafts: Intermediate pressure ahead, and high pressure astern - direct connected.
2. Port and Starboard inboard shafts: Low pressure ahead, and astern turbines direct connected, high pressure ahead turbines via reduction gears.
3. Manufacturers: High pressure ahead by Newport News Shipbuilding and Dry Dock Co., I.P. ahead and L.P. astern by New York Shipbuilding Corp.
Boilers: Four installed. Type - White Forster, Mfg. by Babcock and Wilcox.
Main Condensers: Two installed, 15,230 sq. ft. cooling surface. Mfg. by New York Shipbuilding Corp.
Reduction Gears: Single reduction, (inboard shafts only). Mfg. by Newport News Shipbuilding Co.
Main Shafts: Four installed, outside dia. 12 3/8", bore - 7 1/4. Mfg. by New York shipbuilding Corp.
Propellers: Four installed, 3 blades. Mfg. by New York Shipbuilding Corporation.



MIDSHIP SECTION

TEST A

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

Drafts before test were 30' 3" forward and 31' 0" aft.

The list was about 1/4 degree to starboard. The draft and list after test are substantially the same. Some minor flooding occurred in the stern as the result of leakage through the rudder post.

(b) Structural Damage.

HULL

Damage to the forward superstructure is extensive but relatively insignificant with respect to operation of the vessel. The smokestack is badly damaged. The mainmast is moved forward and to port and the after starboard leg of the tripod is pulled free at the main and second decks. The main deck has suffered a major panel deflection aft of Turret 6 and minor deflections forward of this area of the starboard side.

The hull above the waterline along the starboard side aft is dished generally. The interior structure is generally undamaged except on the second deck aft at about frame 125 where deflection of the main deck has caused considerable damage to structure below.

MACHINERY

The stack was torn away at its base and fell over to port in such a position as to completely block the gas passage from the uptakes. The upper part of the uptakes were distorted by the carrying away of the stack. The port crane was moderately damaged and the starboard crane severely damaged structurally. Deflection of the main deck aft caused severe damage to the after deck winch. One

boat went overboard. Structural damage to decks and bulkheads crushed the butcher shop equipment and caused minor damage to galley equipment.

ELECTRICAL

Electrical damage occurred in areas as indicated below.

1. Both masts.
2. Main deck aft.
3. Second deck aft.
4. Superstructure forward and aft.

(c) Other damage.

HULL

The machinery plant is operable after ship's force repairs. Ship control is operable. Fire control is operable except for radar.

MACHINERY

Boilers 3 and 4 were considerably damaged, #2 lightly damaged. All significant damage to boilers was to casing panels, which were blown out and in some cases ruptured. The after deck winch was severely damaged and is considered to be beyond repair. The port crane was considerably damaged. This damage was largely structural but there was some damage to hydraulic machinery of this unit. The starboard crane rotating platform was thrown off its rollers, platform cracked, and gear crane housing blown off. One motor whaleboat was blown overboard. On the other boat, the muffler exhaust pipe and battery lugs were broken off. The auxiliary exhaust steam line was cracked in two places in the engine room. Butcher shop equipment was demolished. There was minor damage to galley equipment.

ELECTRICAL

Damage to electrical equipment in general was of a minor nature. Operability remained essentially the same as before Test A except those damaged as listed below.

1. Two-36", one -24", and four-12" searchlights.
2. Running and signal lights.
3. After deck winch.
4. Four vent sets.
5. Two master gyro compasses.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

Heat radiation originated at a point bearing about 135 degrees relative. Exposed paint, wood decking and cordage is scorched and blackened. Some paint isblistered. Both horizontal and vertical surfaces are affected. In some places two coats of paint are burned. Blistering is extensive and there is an unusual amount of paint peeling.

MACHINERY

Paint on exposed surfaces was charred and blistered. Otherwise, there is no evidence of heat in machinery spaces or on exposed machinery.

ELECTRICAL

Radiant heat scorched the paint on electrical equipment exposed directly to the blast. Some cables on the foremast were affected to the extent that beads of insulation protruded through the armor.

(b) Fires and Explosions.

HULL

Fires on board were not extensive and did not jeopardize the safety of the vessel. U.S. Army Quartermaster test equipment on the superstructure deck, frames 55 to 68, starboard and 48 to 56, port, burned as the result of direct heat radiation. The equipment consisted of rations, mess kits, battle helmets, blankets, tents, clothing, skis, and similar articles. Fire occurred in every case where equipment packed in waterproof paper covered with sacking was exposed to radiation. Cardboard and wooden boxes similarly exposed, scorched, but did not ignite as did the sacking material. Wood decking burned in way of these fires. A small fire occurred in the boat shop at frame 72, main deck, starboard, where a mattress and internal paintwork burned. The hatch overhead was blown off by the air blast and it is probable that the fire was caused by embers from the burning quartermaster gear entering the hatch.

MACHINERY

There is no evidence of fires or explosions in machinery spaces or on exposed machinery.

ELECTRICAL

Damage by fire to electrical equipment was negligible. One-12" signal searchlight had its portable cable burned by fire on bridge wing.

No explosion occurred.

(c) Shock.

HULL

There are minor evidences of shock. Ready service boxes are lifted off foundations. Cast iron foundations for equipment in the potato peeler room, frame 64, starboard, on the main deck, are fractured

MACHINERY

There is no evidence of shock.

ELECTRICAL

No damage to electrical equipment occurred that can be attributed directly to shock. Electrical damage attributed indirectly to shock at time of structural failures [illegible] as follows:

1. The after warping winch control resistance was broken.

2. Portable batteries jumped out of their racks.

3. The overload relay spring for doughmixer popped out of place.

(d) Pressure.

HULL

The air blast wave originated at a point bearing about 135 degrees relative. Flat surfaces are more seriously affected than curved surfaces. The sheer strake on the starboard side aft is dished to a maximum depth of eight inches. The main deck aft of Turret 6 is depressed about two feet. The after fire control tower is moved bodily forward and to port. This caused compressive failures in the forward and port tripod legs and pulled the starboard leg free at the main and second decks. Structure in the tower is essentially intact except that exposed bulwarks are bent inboard and nearly all door frames are distorted. The stack is bent forward and to port and is torn. The foremast structure is generally intact. The range-finder platform on the 05 level at the rear of the foremast has been lifted by air shock, tearing the supporting beams. All sheet metal and expanded metal topside has suffered considerable damage. Exposed sun shields on ready service boxes are bent upward. Flat surfaces of exposed bulkheads and gun tubs are generally dished. Door frames are generally distorted even in shielded locations.

MACHINERY

All major damage to the machinery installation was caused by blast pressure or by deflection of decks and bulkheads which was caused by blast pressure. Minor damage is believed to have been caused by the whipping motion of the ship following the blast. The blast apparently came from slightly aft of the starboard beam.

ELECTRICAL

The blast pressure wave came from about 125° relative. Electrical damage attributed to pressures are as follows:

1. The after warping winch made inoperable when deck support gave way.

2. Searchlights except three-12'' signal lights on the port wing of the bridge are damaged and inoperable.

3. Some cables were damaged by structural failure.

4. The vertical fighting lights, running lights and anchor light were inoperable due to structural failures flying object and open circuits.

5. Ventilating motor impellers were bent due to pressure impeller housings.

(e) Any effects apprently peculiar to the Atom Bomb.

HULL

Aside from radioactivity, the application of heat and high pressure over large areas is an effect peculiar to the Atomic Bomb.

MACHINERY

A blast pressure of this magnitude is believed to be peculiar to the Atom Bomb.

ELECTRICAL

No effects to electrical equipment peculiar to the bomb occurred.

III. Effects of Damage.

(a) Effect on machinery, electrical and ship control.

HULL

Propulsion was temporarily lost but is now in operation using a jury stack. Ship control is operable.

MACHINERY

All steam power was lost. The after deck winch and butcher shop equipment are beyond repair. The cranes require major repairs, although emergency repairs to the port crane to make it temporarily operable could be made by the ship's force. The engine of the one remaining motor whaleboat could be repaired by the ship's force if spare parts were available. All other damage to machinery is minor and could be easily repaired by the ship's force. It is estimated that the ship's force require at least 4 days to make temporary repairs to enable the ship to steam at slow speed. It is estimated that approximately 45 working days at a shipyard would be required to restore the ship to normal operating conditions. The effect on ship control from a machinery viewpoint was to limit power to that furnished by the two (100 kw) emergency diesel generators.

ELECTRICAL

Effect on electrical equipment was negligible. Ship control was not affected, emergency diesel generators were both operable. With the return of steam the main turbo-generator was operable. Both master gyros were operable on replacing mercury that had spilled.

(b) Effect on gunnery and fire control.

HULL

Gunnery and fire control are operable except for radar.

MACHINERY

No comment.

ELECTRICAL

1. Effect of electrical damage to gunnery was negligible.

2. Effect of electrical damage to fire control was negligible.

(c) Effect on watertight integrity and stability.

HULL

Watertight integrity is only slightly affected. Stability is not affected.

MACHINERY

No comment.

ELECTRICAL

Electrical equipment had no effect.

(d) Effect on personnel and habitability.

HULL

Topside personnel would have incurred casualties from radiation, heat, and air blast. Some casualties would have occurred below decks from shock and the deformation of the main deck, aft.

Habitability would have been seriously reduced on the second deck between frames 120 and 130. The remainder of the vessel is in good condition.

MACHINERY

It is estimated that there would have been a high percentage of casualties in the afer fireroom and some casualties in the forward fireroom if the ship had been steaming at the time of the test. It is not believed that there would have been any other personnel casualties below decks, although casualties among exposed personnel would have been high. Habitability is reduced by loss of steam power, and to a minor extent by damage to galley and butcher shop equipment.

ELECTRICAL

Electrical effect was negligible. Confined entirely to damage to ventilation such as impeller housings.

(e) Total effect on fighting efficiency.

HULL

The vessel would have been immobilized for several hours. Electronic equipment is inoperable. Topside personnel would have been incapable of functioning for some time.

MACHINERY

The ship is immobilized and is no longer an effective fighting unit. It is estimated that 45 working days at a shipyard would be required to restore her machinery to normal condition.

ELECTRICAL

Electrical effect on fighting efficiency would have been negligible.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

Personnel and main machinery installations are most seriously affected. Masts and tower structures proved inadequate against the attack. Except for topside personnel casualties and damage to stacks, uptakes, and boilers, this ship would have been able to keep at sea as a fighting unit with reduced efficiency because of the loss of the radar.

MACHINERY

It is not believed that a modern battleship, exposed to a similar attack at the range of the ARKANSAS would have been immobilized, although some damage to boilers would probably have occurred. The stacks of the ARKANSAS would probably not have carried away if it had been in good condition, although it would undoubtedly have been damaged. The ARKANSAS's stack was severely corroded before Test A.

ELECTRICAL

1. No electrical damage to ship's service generating plant occurred.

2. Interior communications had slight disruption mainly on distorted superstructures.

3. Electrical damage to ventilation was negligible.

4. Searchlights received the major part of electrical damage.

5. In general electrical damage had no major effect on this ship.

V. Preliminary General or Specific Recommendations of Inspection Group.

HULL

Methods should be developed to protect boiler installations from blast damage. All topside personnel, especially those in gunnery and fire control stations should be protected.

Personnel in 12 inch turrets were unhurt but the commanding Officer estimates that 80% of all other gunnery and fire control personnel would be casualties. In general, superstructure should be strengthened and faired with all overhangs eliminated.

MACHINERY

Stacks and boiler casings should be made more resistant to blast pressure.

Steps should be taken to insure that stacks of all vessels are inspected and repaired as required to preserve their original strength.

ELECTRICAL

Specific recommendations are given in part C for each item where applicable.

TECHNICAL INSPECTION REPORT

SECTION I - HULL

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

Drafts before test were 30' 3" forward and 31' 0" aft.

The list was about 1/4 degree to starboard. The drafts and list after test were substantially the same. Some minor flooding occurred in the stern as the result of leakage through the rudder post.

(b) Structural damage.

Damage to the forward superstructure is extensive but relatively insignificant with respect to operation of the vessel. The smokestack is badly damaged. The mainmast is moved forward and to port and the after starboard leg of the tripod is pulled free at the main and second decks. The main deck has suffered a major panel deflection aft of Turret 6 and minor deflections forward of this area on the starboard side.

The hull above the waterline along the starboard side aft is dished generally. The interior structure is generally undamaged except on the second deck aft at about frame 125 where deflection of the main deck has caused considerable damage to structure below.

(c) Other damage.

The machinery plant is operable after ship's force repairs. Ship control is operable. Fire is operable except for radar.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Heat radiation originated at a point bearing about 135 degrees relative. Exposed paint, wood decking and cordage is scorched

and blackened. Some paint is blistered. Both horizontal and vertical surfaces are affected. In some places two coats of paint are burned. Blistering is extensive and there is a unusual amount of paint peeling.

(b) Fires and explosions.

Fires on board were not extensive and dit not jeopardize the safety of the vessel. U.S. Army Quartermaster test equipment on the superstructure deck, frames 55 to 68, starboard and 48 to 56, port burned as the result of direct heat radiation. The equipment consisted of rations, mess kets, battle helmets, blankets, tents, clothing, skis, and similar articles. Fire occurred in every case where equipment packed in waterproof paper covered with sacking was exposed to radiation. Cardboard and wooden boxes similarly exposed, scorched, but did not ignite as did the sacking material. Wood decking burned in way of these fires. A small fire occurred in the boat shop at frame 72, main deck, starboard, where a mattress and internal paint work burned. The hatch overhead was blown off by the air blast and it is probable that the fire was caused by embers from the burning quartermaster gear entering the hatch.

(c) Shock.

There are minor evidences of shock. Ready services boxes are lifted off foundations. Cast iorn foundations for equipment in the potato peeler room, frame 64, starboard, on the main deck are fractured.

(d) Pressure.

The air blast wave originated at a point bearing about 135 degrees relative. Flat surfaces are more seriously affected than curved surfaces. The sheer strake on the starboard side aft is dished to a maximum depth of eight inches. The main deck aft of Turret 6 is depressed about two feet. The after fire control tower is moved bodily forward and to port. This caused compressive failures in the forward and port tripod legs and pulled the starboard leg free at the main and second decks. Structure in the tower is essentially intact except that

exposed bulwarks are bent inboard and nearly all door frames are distorted. The stack is bent forward and to port and is torn. The foremast structure is generally intact. The rangefinder platform on the 05 level at the rear of the foremast has been lifted by air shock, tearing the supporting bearms. All sheet metal and expaned metal topside has suffered considerable damage. Exposed sun shields on ready service boxes are bent upward. Flat surfaces of exposed bulkheads and gun tubs are generally dished. Door frames are generally distorted even in shielded locations.

(e) Effects apparently peculiar to the atom bomb.

Aside from radioactivity, the application of heat and high pressure over large areas is an effect peculiar to the atomic bomb.

III. Effects of Damage.

(a) Effect on machinery, electrical and ship control.

Propulsion was temporarily lost but is now in operation using a jury stack. Ship control is operable.

(b) Effect on gunnery and fire control.

Gunnery and fire control are operable except for radar.

(c) Effect on watertight integrity and stability.

Watertight integrity is only slightly affected. Stability is not affected.

(d) Effect on personnel and habitability.

Topside personnel would have incurred casualties from radiation, heat, and air blast. Some casualties would have occurred below decks from shock and the deformation of the main deck, aft. Habitability would have been seriously reduced on the second deck between frames 120 and 130. The remainder of the vessel is in good condition.

(e). Effect on fighting efficiency.

The vessel would have been immobilized for several hours. Electronic equipment is inoperable. Topside personnel would have been incapable of functioning for some time.

IV. General Summary of Observers' Impressions and Conclusions.

Personnel and main machinery installations are most seriously affected. Masts and tower structures proved inadequate against the stack. Except for topside personnel casualties and damage to stacks, uptakes, and boilers, this ship would have been able to keep at sea as a fighting unit with reduced efficiency because of the loss of the radar.

V. Preliminary General or Specific Recommendations of Inspection Group.

Methods should be developed to protect boiler installations fr[illegible] blast damage. All topside personnel, especially those in gunnery and fire control stations should be protected.

Personnel in 12-inch turrets were unhurt but the Commanding Officer estimates that 80% of all other gunnery and fire control personnel would be casualties. In general, superstructure should be strengthened and faired with all overhangs eleminated.

VI. Instructions for loading the vessel specified the following:

ITEM	LOADING
Fuel oil	50%
Diesel oil	50%
Ammunition	50%
Potable and reserve feed water	Full load
Salt water ballast	2040 Tons.
Gasoline	50%

Details of the actual quantities of the various items aboard are included in Report 7, Stability Inspection Report, submitted

by the ship's force in accordance with "Instructions to Target Vessels for Tests and Observations by Ship's Force" issued by the Director of Ships Material. This report is available for inspection in the Bureau of Ships Crossroads Files.

DETAILED DESCRIPTION OF HULL DAMAGE

A. General Description of Hull Damage.

(a) Overall condition of vessel.

The overall condition of the vessel is good and it is operable with temporary repairs within the capacity of the ship's force.

General views of the exterior are shown on pages 2 to 24, inclusive.

(b) General areas of hull damage.

The foremast structure has extensive but minor damage to light elements. The stack is crushed and torn. The mainmast structure is moved bodily forward and to port. A major panel failure has occurred in the weather deck, aft of frame 120. Damage extends to second and third deck spaces below in this area. The starboard blister and hull plating is dished from frame 70 to the stern.

(c) Apparent causes of hull damage in each area.

Most damage is the result of air blast pressure. Paint, cordage, and wood decking are damaged by heat and local fires.

(d) Principal areas of flooding with sources.

The steering gear spaces and magazine D-25 flooded through rudder trunk leakage. Flooding is of minor importance.

(e) Residual strength, buoyancy and effect of general condition of hull on operability.

The strength of the hull is not appreciably affected by the damage. Buoyancy is unimpaired. The general condition of the hull has no effect on operability.

B. Superstructure.

(a) Description of damage.

1. Bridge area.

The SG radar array castings are cracked or broken. The eight inch pole mast supporting the SG radar array is collapsed about four feet above the main radar platform and is bent forward so that it is resting in a downward position against the upper port yardarm. (Photos 2091-3, 2097-3, 2094-1, pages 25, 26, and 27). The upper yardarm clamps are loosened and the yardarm has moved about six inches to port. The after port and starboard wing of the radar platform are distorted. The starboard wing is bent upward at a forty degree angle. (Photos 2097-3, 2094-1,3, 2135-6, pages 26, 27, 28, and 29). The ten pound plate platform and four inch by ten pound plate coaming is rippled and twisted. The coaming has a two inch crack on the starboard side at about frame 54. Handrails are twisted. The SK radar antennae is missing. (Photo 2094-3, page 28).

The FC radar antenna, atop the main battery control station, is missing. The top of the main battery control station is moved forward about one foot relative to its former position. Window pilasters are bent and distorted and bolts are loosened. (Photos 2094-4, 2091-1, pages 30 and 31). The box girder, (10" x 10" x 7.5 lbs.), cantilever, under the canopy of the main battery control station, which supports the FC radar array is broken about four feet forward of the pole mast supporting the main radar platform. The 15-inch pole mast supporting the radar platform is bent forward and to port in a smooth curve. (Photos 2097-3, 2135-4, pages 26 and 32). The shield and platform of the main battery control station are undamaged except for local distortions made by falling objects.

The top of the secondary battery control station is intact. The vertical ladder leading to the main battery control station on the port side is torn loose at its upper connections and is torn loose from one bottom pad. The ladder is twisted. The signal yardarm is generally intact except for the starboard tip which is moved forward. The

shield around the secondary battery control station is dished on the starboard, diagonal aft, and after faces. The window pilasters are blown out on the starboard side (photo 2097-3, page 26).

The binnacle platform is largely intact. The handrail on the port side is broken.

On the top of fire control station, level, the director appears to be normal except for dishing of the door in the after face to a depth of three inches. Mark 51 director positions (10 pound plate) are intact, (photo 2094-2, page 33). The longitudinal splinter shields, port and starboard, are intact to a point about six feet aft of the director positions. Aft of this point, the starboard shield is pushed inboard about fifteen inches, maximum at the top (photo 2094-2, page 33). Stiffeners on the outboard side of the shield are cracked and distorted (photos 2094,2, 5, pages 33 and 34). The port shield is bowed outboard about eight inches and stiffeners are buckled in compression (photo 2095-1, page 35). The panels of the radar station, just forward of the center leg of the tripod, are bent severely (photo 2094-2, page 33). Cables are torn and castings broken. Ladder handrails and attached shields are deflected forward. The 20 pound plate shield on the after edge of the platform is deflected forward so that the top edge is about one foot out of line. (Photos 2094-6, page 36). The entire rangefinder platform which overhangs the deck below is lifted upward by the air blast, fracturing the supporting cantilever beams. The starboard wing appears to be bent upward while the port wing appears to be bent slightly downward. (Photos 2097-3, 2095-9, pages 26 and 37). The port cantilever failed at the port after tripod leg. (Photos 2094-11, 10, pages 38 and 39). Failures occurred at the starboard after tripod leg due to lifting of the rangefinder platform. (Photos 2135-3, 1782-12, 11, 2094-8, pages 40, 41, 42, and 43).

There is no significant damage to the forward portion of the ship and fire control level. The port side is also largely intact. The starboard windbreak is bowed slightly and the venturi screen is dished in each panel. (Photo 2094-5, page 34). The starboard and after sides of the house are dished about one inch and stiffeners are distorted. Overhead T-bar stiffeners, under the rangefinder platform, are broken where welded to the after bulkhead of the house. (Photo 2094-12, page 44). The after bulwark running between the two wing tripod legs is deflected forward about eight inches.

On the navigating bridge level, damage is confined to the after end of the platform. The flag bags are demolished and supports distorted. The small house between the tripod legs is severely dished on the after and starboard faces (photo 2095-9, page 37). The transverse passageway between this house and the main deck house (frames 52 to 53) acted as a blast trap. The forward bulkhead of the radio shack is deflected aft considerably (photo 2095-2; page 45). The after bulkhead of the deck house is deflected forward. The top of the shack is also dished because of reflection from the overhanging rangefinder platform above.

Structure on the bridge deck level is largely intact. Damage is confined to light structures near the after end of the level. The life jacket lockers, port and starboard, along the after rail, are severely distorted (photos 2095-6, 5, pages 46 and 47). Ready service lockers, port and starboard at frame 48, are dished on all sides (photos 2095-4, 7, 3, pages 48, 49, and 50). The starboard shield at frame 49 (10 pound plate) is deflected about three inches.

There is no apparent damage on the superstructure deck level forward of frame 48. Fires in U.S. Army test equipment resulted in scorched paint and burned wood decking at frames 48 to 56 port, frames 52 to 56 starboard, and frames 56 to 60 starboard (photos 1775-7 2091-4, pages 51 and 52). Light metal lockers in this area are dished (photo 2091-4, page 52). Mesh in the vegetable lockers at frame 56, centerline, is torn (photo 1775-7, page 51). At frame 60, starboard, the hood over a ventilator opening is severely distorted (photo 2095-12, page 53). The port boat crane is operable. The shield at its top is buckled (photo 2097-3, page 26). The starboard crane is inoperable and its shield is slightly dished (photos 2147-3, 2146-4, pages 54, and 55). The stack is crushed in a direction forward and to port, and is torn free from the uptakes. Coincident with bolt and rivet failures in the stack, it is apparent that the outer casing was struck by the sharp corner of an angle stiffener on the after starboard corner of the high coaming surrounding the stack base. Progressive failure of bolts and rivets appears to have occurred, commencing at the after starboard corner of the rectangular base. Final failure of connections on the port side indicate an upward prying action as the stack fell to port over the high coaming. (photos 1897-7, 6, 1775-10, 2091-6, pages 56, 57, 58 and 59). Bolts proved ineffective in tension and sheer as bolt holes are not generally deformed. Countersunk rivets holding the lower edge of the outer casing did

considerable work before pulling through the casing plating, as evidenced by many elongated rivet holes. The casing plating appears to be too thin to develop the full strength of these rivets. The uptake division plates below the stack base remain essentially undamaged. (photo 1897-8, page 60).

The after bulkhead of the radar house at frames 64 to 68, centerline, is badly damaged (photo 2095-11, page 61), apparently as the result of deflection of the blast onto the bulkhead by turret 3 just aft. The starboard side of the house is deflected only slightly (photo 2091-5, page 62).

On the main deck level, the 5 inch broadside battery between frames 40 and 60 is protected by a light deck overhead extending from frame 39 to frame 61, port and starboard. These enclosures are practically undamaged. (Photos 2090-4, 12, pages 63 and 64). Gun port covers on the starboard side are distorted (photo 2090-5, page 65). The after bulkhead frame 61, starboard, is very slightly dished. The after bulkhead frame 61, port is deflected considerably, especially at the access opening. (Photo 2135-1, page 66). The coaming plate is pulled from the wood deck at the inboard edge of the door frame. The shell plating fashion plate is deflected outboard and has sheared its riveted connection to bulkhead 61. The longitudinal bulkhead forming the inboard boundary of the starboard battery is slightly dished and compartment and locker doors are also dished. The doors at frame 51 and frame 56 are bulged outboard. The athwartship passageway at frame 51 is exposed to the blast by open companionways, port and starboard. All doors opening into this passageway are dished inward; the port bulkhead of the passageway is carried away at the deck connection; and the bulkhead panels are dished considerably.

Aft of frame 61, the starboard deckhouse bulkhead is severely dished, the maximum deflection being about 12 to 14 inches at frame 65. The severity of this damage is apparently due to the fact that the air blast, originating broad on the starboard quarter, was trapped under the overhang, frames 66 to 73, thus concentrating its force on the deckhouse bulkhead. (Photo 2134-9, page 67). The overhanging is blown upward in way of the 40mm ready service room,

frames 70 to 73. (photos 2134-9, 2095-10, 1097-12, pages 67, 68 and 69). The starboard side of the deckhouse between frames 63 and 68 has severe damage to the bulkhead, doors, and door frames (photos 2090-3, 2097-11, 1775-6, 2134-11, 1782-8, pages 70, 71, 72, 73, and 74). There is a vertical tear in the bulkhead plating adjacent to a bulkhead stiffener. A vertical, riveted lap joint in the plating formed an additional discontinuity. The next two stiffeners, forward, have pulled through their riveted connections in the lower portion of the bulkhead. The bulkhead is deeply buckled and torn just aft of the door frame at frame 64 (photos 2090-3, 1782-9, pages 70, and 75). These tears are in way of an interior transverse bulkhead. The door frame at frame 64 is badly distorted and the door frame is torn at the upper right fillet. (photo 1782-10, page 76). The failure extends into the upper margin plate along a row of rivets.

Blast and fire damage is evident in the boat shop (main deck frames 70 to 73, starboard side). The hatch to this space, located in the superstructure deck, is blown off. (photo 2095-10, page 68). The air blast apparently entered the boat shop through this hatch and blew open the watertight door in bulkhead 73, bending it over an adjacent ready service box. (photo 2091-10, page 77). The ready service box is moved on its foundation. In addition, sparks, apparently originating in the fires forward on the superstructure deck level, entered through the hatch and ignited cordage stowed in the boat shop. A severe but localized fire ensued.

On the port side, the bulkhead between frames 61 and 73 is also dished but to a much lesser extent than on the starboard side. (Photos 2090-11, 2134-12, pages 78 and 79). The port door in bulkhead 73 is dished slightly and a glass port light is blown in.

2. After deckhouse and tower.

The main topmast has fallen forward from its position on the director platform at frame 96, centerline, and is hanging bottom up, supported by electric cables which run up the mast. (Photos 1775-12, 1895-6, 9, 8, pages 80, 81, 82, 83, 84). The foot of the mast was welded to an 18 inch square doubler (10 pound plate)

and was braced by four, 4" x 6" brackets. The doubler was welded to the deck by a continuous weld with 25-20 electrods. The doubler is pulled loose from the deck. (Photos 1895-10, 11, pages 85, and 86). On three sides the doubler tore at the edge of the heated zone adjacent to the weld. The doubler tore about 1-1/2 inches from the weld on the fourth (starboard forward) side. The forward mast guy is parted about eight feet above the deck. The port after guy is parted near the top of the mast. The starboard after guy is parted nearly 12 feet above the deck. The starboard yardarm of the mast, restrained by a guy, is bent sharply about three feet from the mast.

The entire mainmast tower structure is bent forward and to port. (Photo 2091-7, page 87). The starboard leg is pulled free of the main and second decks (photos 2097-7, 2146-5, 6, 7, pages 88, 89, 90, 91). The port leg is wrinkled just above the wrapper plate about four feet above the main deck (photos 2111-10, 9, 2134-7, pages 92, 93, 94). The forward leg has a compression wrinkle and bend, about four feet above the main deck (photos 2089-9, 2111-7, 8, 2134-8, pages 95, 96, 97, 98). The forward leg has also worked at the main and second deck connections (photos 2146-10, 9, pages 99, 100).

The 20mm clipping room on the main deck level is dished inward on the port, starboard, and after sides. (photos 2089-7 10, 2111-11, pages 101, 102, 103). On the superstructure deck (01) level, the house has been lifted about eight inches as the result of the lifting of the starboard tripod leg (photos 2089-10, 2111,11, pages 102, 103). The 01 deck is torn at the after starboard corner outboard of the house and wrinkled in way of the mast leg, (photos 2111-11, 1783-4, 2146-3, pages 103, 104, 105). The port forward corner of this level is depressed. The starboard door in the forward face is dished (photo 2097-5, page 106). The stanchions supporting the 20mm gun platform (02 level) are buckled, the port stanchion severely (photos 1895-6, 2089-7, 10, 8, pages 82, 101, 102, 107). On the 02 level, the after shield is dished forward (10 pound plate) and the straight sections of the port and starboard bulwarks are bent to port (photo 2089-10, page 102). The plating of the 20mm gun platform (02 level) is cracked around the starboard tripod leg (photo 2146-2, page 108).

The bulwark surrounding the radar platform (03 level is distorted slightly (photo 1775-12, page 80). This shield is fabricated of 10 pound plate. Pipe supports for the blinker searchlights are snapped (photo 2097-4, page 109). On the 3-inch director and searchlight platform (04 level), all shields are deflected forward and to port (photos 1775-12,1895-8, 2097-1, 2, pages 80, 84, 110, 111). The starboard searchlight is now lying on the main deck (photo 1775-3, page 112). The glass and shutter are missing from the port searchlight which was facing the blast. Pipe railings on the 05 level are bent and torn (photo 1895-8, page 84).

(b) Causes of damage in each area.

Air blast pressure was the principal cause of damage except where damage occurred as the result of local fires.

(c) Evidences of fire in superstructure.

The wood decking on the superstructure deck level is burned at the following locations.

1. Port side, frames 49 to 55, an area twelve feet by thirty feet.

2. Starboard side, frames 54 to 56, an area six feet by ten feet (photo 1775-7, page 51).

3. Starboard side, frames 57 to 59, an area three feet by eight feet (photo 2091-4, page 52).

The decking is burned through to the metal deck. These fires are the result of ignition of U.S. Army Quartermaster equipment that was secured in these locations. Only exposed items which were wrapped in burlap caught fire.

A fire was ignited in the boat shop, frames 71 to 73, starboard, main deck level. Hatch 01-71-1 was blown off and was found about 20 feet forward. It is probable that sparks or burning material from the fires in the U.S. Army equipment just forward on the superstructure deck entered through the opened hatch, igniting the material in the boat shop. The fire was confined to this space and burned itself out.

(d) Estimates of relative effectiveness against heat and blast of:

1. Various plating thickness.

In general, 10 pound plating is ineffective in flat panels exposed to the blast. 15 pound plate is effective. An exception appears to be the 5 pound plate venturi on the bulwark of the 03 level of the mainmast which is only slightly damaged. This plate is ten inches wide and is supported every twenty inches.

2. Various shaped surfaces.

Curved surfaces, especially cylindrical surfaces, have a marked superiority over flat surfaces in resistance to deformation and rupture.

3. STS compound to MS.

There is no appreciable difference in behavior of STS and MS against air blast or heat for comparable scantlings.

The effects of hear are generally limited to surface scorching and blistering of paint, wood and cordage.

(c) Constructive criticism of superstructure design or construction.

Mast tripods should be redesigned to resist movement of the structure under blast. In general, superstructures should be lowered and faired up, avoiding blast traps and making maximum use of curved and cylindrical surfaces. Personnel positions topside should be fully enclosed.

C. Turrets, Guns and Directors.

(a) Protected mounts.

1. General condition, including operability, if known.

The 12-inch turrets are operable except for the right gun of turret 4. The right trunnion bearing for this gun is fractured and,

although the gun can be elevated with ease, it cannot be fired, (photos 1991-1, 2, 4, pages 113, 114, and 115). The nature of the fracture indicates that the failure was caused by an upward force. During the test, turret 4 was trained to the starboard quarter, facing the point of detonation of the bomb. Both guns were elevated to the maximum of 15 degrees and the breech end was resting on the elevation stops. With the elevation stops serving as a fulcrum, it is believed that the blast struck the underside of the gun barrels, exerting considerable force on the trunnions. This failure constitutes a major casualty and a navy yard availability would be necessary to repair the damage.

The armored hatch in the overhang of turret 5 was forced open by the blast. This hatch has only one dog which either sprung or turned sufficiently to allow the hatch to drop open. The hatch and its fittings are not damaged.

In turret 6 a four-inch diameter ventilation pipe in the blower room is broken off.

The canvas gun port bucklers on turrets 3, 4, 5, and 6 are torn and shredded as a result of the blast.

2. Effectiveness of installed turrets or shields.

Satisfactory.

(b) Unprotected mounts

5''/51 Mounts

Damage to the 5-inch mounts is light. Gun port shutters are damaged from the blast and temporarily impede the operation of the guns, (photo 2090-5, page 65). The vickers receiver regulators are damaged on mounts 3 and 6 as a result of blast but this will not prevent the operation of the mounts. All mounts can be made operable within an hour if necessary.

3''/50 Mounts

Except for the optics, the 3-inch mounts are not damaged and all are operable. The mounts on the starboard side show

the effects of blast and heat more than those on the port side. The guns could be made operable in a short time by replacing optics, but the alignment is completely ruined until boresighting can be accomplished.

40 MM Mounts

The 40 MM mounts are operable by both power and manual control. The ring sights on the starboard mount are distorted. Mount 1 will operate in local control until repairs to the associated Mk. 51 director can be made. Mount 2 is operable in both local and director control.

20 MM Guns.

All guns are operable by tracer control except gun 8. The barrel of this gun is bent having been hit by flying debris. There is no other consequential damage.

1. Effectiveness and sufficiency of crew shelters.

The shields on open mounts are not greatly damaged but they are insufficient for the protection of the crews.

(c) Directors and Rangefinders on 12-inch turrets.

1. General condition, including operability, if known.

The rangefinder, Mk. 10, and its mount have been blown off the top of turret 2. It appears that the holding down clips were sheared off (photo 1897-9, page 116).

The rangefinder, Mk. 10, and its mount are blown off the top of turret 5. The holding down clips did not give way but the mount sheared off above the clips. The roller path is still intact. The damage appeared to be due to secondary causes probably from parts of the shield hitting the mount and knocking it loose (photo 1775-9, page 117).

2. Condition of instruments therein.

The rangefinders, Mk. 10, are damaged beyond repair.

(d) Constructive criticism of design or construction of mounts, directors, foundations and shelters.

In the case of the fractured trunnion bearing, the cap square is not bolted down, as is the general practice in turrets of later design, but is fitted into grooves machined in the trunnion block. These machined grooves have sharp corners in which the fracture originated. Because of the design, a navy yard availability of several weeks duration would probably be required to repair the damage. If a similar mishap were to occur in a modern turret, it is likely that the holding down bolts would fail first. It would be comparatively easy to replace damaged bolts, and it would be possible for the ship to make at least temporary repairs so that the gun could be used.

D. Torpedo Mounts, Depth Charge Gear.

Not applicable.

E. Weather Deck.

(a) General condition of deck and cause of damage.

The main deck is undamaged from the bow to about frame 10 except for slight charring of the wood deck where exposed to the heat radiation. (Photo 2091-2, page 118). Between bulkhead 10 and bulkhead 18, the deck is deflected downward very slightly, the maximum deflection being about one inch at frame 14. The deck is also slightly deflected in the vicinity of frame 36. Between frames 40 and 61, the main deck is protected by the superstructure deck. The condition of the weather deck from frame 40 to 61 is discussed in Item B. Aft of frame 61 on the starboard side, the main deck is dished somewhat locally, particularly around access openings and over second deck passageways. (Photo 2090-1, page 119). The wood deck on the starboard side is slightly charred. The deck is deflected downward slightly between barbettes 3 and 4 (Photo 2090-2, page 120). Between frames 90 and 118 on the starboard side, the main deck is deflected downward to form a wrinkle about two inches deep, running fore and aft about eight feet inboard of the deck edge.

The deck has suffered a major panel failure immediately aft of turret 6 (photo 2089-2, 1, 3, 5, 4, 6, 1775-1, 2134-3, pages 121, 122, 123, 124, 125, 126, 127, and 128). The wooden deck is broken on the starboard side at frame 118. The deck is deflected sharply to a maximum of about 2 feet at frame 125 on the centerline. The general area of major depression extends from frame 120 to frame 130. The movement of the deck in this area resulted in parting of the connection between the main deck and the barbette, (photo 2089-6, page 128).

Aft of frame 130, the deck is in fair condition but is charred by heat radiation where not shielded (photo 1775-8, page 129). The recordings of deck deflection scratch gages and a sketch of the major failure aft of turret 6 are on pages 83 and 84.

(b) Usability of deck in damaged condition.

The deck is usable except in way of the panel failure, frames 120 to 130. A large amount of debris has to be cleaned up (photos 1895,12, 1775-2, 5, pages 130, 131 and 132).

(c) Condition of equipment and fittings.

1. Mooring and towing fittings.

All mooring and towing fittings are undamaged as the result of the test. The after deck winch at frame 125 is down with the deck and is inoperable because of a crushed control panel under the deck which controls the winch motor.

2. Boats and boat-handling, liferafts.

Two motor whaleboats were located on the port side of the superstructure deck at about frame 70. The inboard boat is missing. The outboard boat is rotated about 90 degrees with its bow resting on the 20 MM gun shield outboard of the stowage (photos 1775-10,11, pages 58 and 133). Most life rafts are damaged by the blast. All rafts on the two after turrets are blown down as well as all of those on turret 2. All life rafts on the starboard side are damaged beyond repair.

3. Airplane handling gear.

The starboard crane is inoperable (photos 2147-3, 2146-4, pages 54 and 55). There is no apparent damage to the starboard kingpost and only a slight dishing of the platform shield on the outboard side. The top platform of the port crane is dished, torn, and bent upward on the inboard side.

F. Exterior Hull.

(a) Condition of exterior hull plating and causes of damage.

Hull plating aft of frame 120 is dished inward by air blast about one or two inches from waterline to gunwale, (photo 2090-8, page 134). The sheer strake is deeply dished on the starboard side of the extreme stern. The deflection reaches a maximum of about eight inches between frames 135 and 137, starboard (photo 2096-8, page 135). Plating welded in the old secondary battery gun ports on the second deck is damaged. Welds have failed on ports at frames 65, 120, and 128 (photo 2091-11, page 136). The plating on the stern gun port is dished about four inches but there are no weld failures.

The starboard blister plating aft of frame 50 is dished inward between floors (photo 2090-7, page 137). Maximum dishing of about one foot occurs between frames 97 and 102 (photo 2090-9, page 138). Paint on the starboard hull aft is blistered and burned by heat radiation. The port shell and blister plating are undamaged.

(b) Condition of exterior hull fittings and causes of damage.

The lower edge of the overboard discharge at frame 115, starboard, is split open where the blister plating is dished. This split, which renders blister D-115 non-watertight, is above the waterline.

(c) Details of any impairment of sheer strakes.

There are no failures in the sheer strake. The starboard sheer strake is dished along the after portions as discussed about. In addition, the upper edge of the sheer strake appears to be moved inboard about two inches in way of the deck failure, frames 120 to 130.

(d) Condition of side armor belt.

The side armor is unimpaired, being protected by the blister plating.

G. Interior Compartments (above w.l.).

(a & b) Damage to structural and joiner bulkheads and causes.

There is no damage to structure forward of frame 55 on the second deck. Some second deck joiner bulkheads are slightly distorted near the overhead where the main deck is deflected in the areas between bulkhead 10 and bulkhead 18 and between frames 31 and 38. The after bulkhead of the athwartships passageway, frame 49, is buckled, evidently from pressure through the hatch.

The port and starboard longitudinal bulkheads in way of the uptakes, frames 54 to 66, are bulged slightly into the passageways. The degree is greater on the starboard side. The deflection of the overhead on the starboard side aft of frame 62 may have contributed to this condition.

Between frames 62 and 69, on the starboard side, the main deck overhead is deflected downward slightly and the transverse girders under the deck show stress patterns in the web in way of the intersections with longitudinals (photo 2091-12, page 139). In this compartment, the cylindrical plate blanking of the old secondary gun port has suffered a weld failure at the overhead (photo 2091-11, page 136).

In the vicinity of barbettes 3 and 4, frame 73 to frame 90, the movement of the weather deck under air shock has resulted in minor damage to structural supports below. Between frames 80 and 86, on the starboard side, the transverse deck beams are crushed slightly in way of the stanchions in the outboard bulkhead of the starboard passageway. The same type of damage is evident in the port passageway, between frames 77 to 84. The transverse deck girder at frame 83 is lifted off its supporting stanchion just inboard of the port ladder. The weather deck is depressed on the starboard side between frames 88 and 90 and is pulled away from the starboard after quadrant of barbette 4. At frame 91,

starboard side, the stanchion supporting the transverse deck beam just inside the disbursing office is highly stressed, indicating a downward movement off the deck. As a result of the deck movement. Shell frame brackets at frames 90 and 91, starboard, are slightly buckled. The maximum deflection of the weather deck in this area appears to be about 3/4 inch on the starboard side and about 1/2 inch on the port side, both measurements taken at frame 90. Stanchions and bulkheads on the port and starboard passageways from frame 90 to frame 110 are slightly buckled by the downward movement of the main deck. Frame brackets at frames 108 and 109, starboard, are distorted (photo 2096-12, page 140).

Severe deflection of the overhead begins at about frame 113 on the starboard side (approximately two inches deflection)and at bulkhead 115 on the port side (approximately 1-1/2 inches deflection). The downward set of the overhead increases rapidly to a maximum depression of two feet at frame 125 (photos 2096-2, 11, pages 141 and 142).

At frame 123, the stanchion on the port side at the quarter point is buckled and has tripped the transverse deck beam (photo 2096-3, page 143). A butt connection in the beam has failed. All stanchions from frame 117 to frame 130 are severely buckled (photos 2096-2, 11, 3, 5, pages 141, 142, 143, and 144). Starboard frame brackets are crippled from frame 90 aft with maximum damage to brackets occurring between frames 120 and 130. Port frame brackets under the main deck are crippled from bulkhead 122 aft (photo 2096-10, page 145).

The bulkheads of the crew's washroom (frame 125-1/2 to frame 129) are badly crushed due to the movement of the main deck (photos 2096-11, 3, 2134-6, 4, 2096-4, pages 142, 143, 146, 147 and 148). Bulkheads inside this space are similarly crushed. The second deck is pushed down somewhat aft of the armored portion (frame 122) and is pushed down severely under stanchions, ventilation ducts, and pipes (photos 2096-4, 6, pages 148 and 149). The second deck is pushed down sharply under bulkhead 125-1/2 and is torn at the foot of the bulkhead for nearly the length of bulkhead (photos 2134-4, 2096-4, pages 147 and 148). Centerline stanchions at frames 131 and 132 are crushed downward about two and four inches respectively.

Structural damage on the third deck is largely limited to the area between frames 122 to 132 underneath the major second deck damage. The centerline stanchions at frames 125 and 128 are buckled and beams above are tripped forward (photo 2096-9, page 150). The overhead is deflected downward between bulkheads 122 and 132, with a maximum of 12-inches occurring at frame 125-1/2. Bulkhead 132 is slightly crushed but the deck is not deflected downward aft of this point. Deck beams are sagged severely in way of the maximum deflection, frames 124 to 126, and frame brackets are slightly crippled.

(c) Details of damage to access closures and fittings.

Quick-acting door 3-92-2 is bulged outward several inches in a fashion similar to that of the bulkhead. Watertight door 2-125-2 to the crew's washroom is badly damaged and the door frame is badly distorted (photo 2096-3, page 143). Watertight door 2-129-2 cannot be closed because of distortion of the door frame (photo 2096-11 and 2134-6, pages 142 and 146).

(d) Condition of equipment within compartments.

The general condition of equipment in interior compartments is good. Other than slight derangement of bunks and lockers, damage to equipment is limited to that resulting from distortion or rupture of supporting structures, principally in the damage area between frames 120 and 130 on the second and third decks (photos 2096-3, 9, 2134-6, pages 143, 146, and 150).

(e) Evidence of fire.

There is no evidence of fire in interior compartments.

(f) Damage in way piping, cables, ventilation ducts, etc.

There is some piping damage in the crew's washroom, frames 125 to 134, second deck. The main supply line of flushing water is broken. This supply line is supported from overhead and

the failure resulted from distortion of the deck above. Several branch lines from the flushing water supply to the heads are also broken. In addition, drains from the crew's washroom starboard side, are broken from shock and movement of structure.

Damage to cables is confined to the area near the centerline at frame 125, second deck, and is the result of severe distortion of adjacent structure.

Ventilation failures of two kinds occurred. On the second deck between frames 120 and 130, considerable ventilation duct damage occurred as the result of movement and distortion of decks and bulkheads (photos 2096-2, 3, 5, 6, 7, pages 141, 143, 144, 149, and 151). Elsewhere throughout the ship, damaged ventilation ducts are found where air blast entered through topside ventilation openings. A typical damage of this type is evident at frame 82 to the starboard air intake to third deck spaces and below. The air intake on the main deck is intact (photo 2097-10, page 152). On the second deck level, the duct work is slightly crumpled because of downward deflection of the weather deck (photo 2097-9, page 153). On the third deck level, the duct consists of a large elbow which extends from near the overhead to the blower. This elbow is entirely dislodged from its connection to the blower and the overhead and is lying on its side on the deck (photo 2097-8 page 154). The bottom of the elbow is deeply creased by contact with adjacent structure. Duct work leading from the exhaust side of the blower is bulged outward by blast and several inspection plates are blown off.

(g) Estimate of reduction in watertight subdivision, habitability and utility of compartments.

The main deck and second decks are no longer watertight between frames 120 and 130 with corresponding reductions of watertight integrity of compartments in this area. Habitability and utility of second deck spaces aft of bulkhead 115 is approximately zero because of structural damage. The habitability and utility of the shops on the third deck level between bulkheads 122 and 132 is reduced about ten percent by depression of the overhead and damage to ventilation systems. Throughout the remainder of the vessel, habitability and utility are substantially unimpaired.

H. Armor Decks and Miscellaneous Armor.

(a) Damage to armor deck and causes of damage.

Slightly buckled or stressed stanchions and bulkheads underneath the armor deck between frames 90 and 122 (the after limit of the armored portion) indicate that the armor deck has deflected slightly in this area. A permanent deflection is apparent in way of the fore leg of the mainmast. The downward force of the blast on the superstructure, transmitted through the main mast foreleg and stanchions under the main deck, has depressed the armor deck, buckling bulkheads slightly in the radio transmitter room, frames 92 to 102 on the third deck.

(b) Protection afforded spaces below.

The protection afforded spaces below the armor deck is satisfactory.

(c) Condition around openings.

Conditions around all openings are satisfactory.

(d) Condition of connections to vertical armor.

No damage.

I. Interior Compartments (below w.l.).

(a) Damage to structure and causes.

Damage to structure below the third deck is confined to slight buckling of the longitudinal bulkhead separating the two engine rooms. The bulkhead is buckled between frame 99 and frame 100 as the result of forces transmitted through the mainmast foreleg which foots on the third deck at frame 99 (photos 2147-1, 2146-12, page 155 and 156).

(b) Damage to joiner bulkheads and causes.

No damage.

(c) Details of damage to access closures and causes.

No damage.

(d) Condition of equipment within compartments.

No apparent damage.

(e) Flooding.

There is no flooding resulting directly from test damage. The major flooding consists of flooding in the steering gear room and a magazine, D-19-MS, as the result of leakage through the rudder post stuffing box.

(f) Damage in way of piping, cables, ventilation, shafts, etc..

No apparent damage.

(g) Estimate of reduction in watertight subdivision, habitability and utility of spaces.

Condition of spaces is unimpaired.

J. Underwater Hull.

There is no apparent or suspected damage to the underwater hull.

K. Tanks.

Other than a cracked overboard discharge line at frame 115, starboard, in way of blister compartment D-115, no damage to tanks is believed to have occurred.

L. Flooding.

(a) Description of major flooding areas.

Flooding occurred in the steering gear room, D-29, and in magazine, D-19-M.S. Minor flooding occurred in the shipfitter and carpenter shop (photo 2096-9, page 150).

(b) Sources of flooding.

The shipfitters and carpenter shop suffered minor flooding from rainwater through openings in the main and second decks. The steering gear room and the magazine have a common gravity drain to the starboard engine room. The valve in the engine room bilge was closed and as a result, flooding water backed up to a depth of ten inches in D-29 and twenty-two inches in D-19-M.S.

(c) List of compartments believed to have flooded slowly so as to be susceptible to damage control.

All flooding could have been controlled if the crew had been aboard.

M. Ventilation.

(a) Damage to ventilation systems and causes.

1. Ducts.

With the exception of the air intake duct at frame 82, which is damaged by air blast entering the topside closure, most damage to ventilation ducts is the result of distortion or movement of adjacent structure. Details of damage to duct work are described in Item G.

2. Closures.

There is no apparent damage to ventilation closures.

3. Effect on habitability.

Ventilation damage has reduced habitability of compartments below the second deck aft of frame 120 considerably but other areas are relatively unaffected.

(b) Evidences that ventilation system conducted heat, blast, fire or smoke below decks.

Aside from blast damage to the ventilation system at frame 82, starboard, there is some evidence that ventilation systems allowed blast to enter topside ventilation openings and to reach the second deck level. There is no evidence that any system permitted heat, fire, or smoke to penetrate below decks.

(c) Evidences that ventilation systems allowed progressive flooding.

None.

(d) Constructive criticism of design and construction of ventilation system.

The age of the ventilation system on this vessel is such that it does not merit detailed criticism.

N. Ship Control.

Aside from damage to radar arrays and associated electronic ship control equipment, damage to ship control stations and equipment, damage to ship control stations and equipment is of a minor nature.

O. Fire Control.

(a) Damage to fire control stations and causes.

1. Directors and elevated control positions.

The main battery gun directors, Mk. 50, which were not operable before the test, received additional damage as a result of the test. The shield on the forward director is badly scorched and internally the station is badly burned and blistered. The left half of the door is blown part way into the director. The tripod structure of the main mast, on which the after director is mounted, is bent forward, throwing the director out of line.

The forward air defense gun directors, Mk 51 Mod 3, are inoperable but can be repaired in a comparatively short time. The after Mk 51 Mod 3 directors have no protecting structure to deflect the blast and therefore suffered greater damage than the forward directors. The shields are blown around both after directors preventing operation through the full arc of train. Elevation of the after starboard director is also prevented by the damage to the shields. The supporting decks are damaged from the blast and tilted, destroying the alignment of both after air defense directors.

Four of the six gun sights, Mk 14 Mod 6, were operable before the test. Only two of the remaining four survived the test without casualties. Five of the six gun sights for the gun directors Mk 51, and their associated directors are inoperable as a result of the test. All but one of the range finders are seriously damaged. Many telescopes and periscopes are casualties.

The fire control radar equipment suffered heavy damage. All search radar antennae are carried away or destroyed.

2. Plot rooms and protected spaces.

Satisfactory.

(b) List of stations having insufficient protection and estimated effect of fighting efficiency of the loss of each.

All exposed stations on the mainmast are out of commission because of damage to individual items, or the unstable condition of the mainmast, or both. Two of the 20MM mounts can fire by tracer control. Ther personnel in this area probably would not have survived the blast.

The exposed stations on the foremast suffered less damage than the mainmast on the levels below the air defense forward. All material on air defense forward level, except the Mk 51, Mod 3 directors, and all material above this level, are rendered inoperable. The personnel in this area probably would not have survived the blast. The stations on the lower starboard levels suffered temporary damage than can be repaired by ship's company.

The rate of fire on all guns could be maintained at the normal rate, but accuracy in main and secondary battery fire would be about 40 percent of normal on opening fire and increasing to about 70% with spotting. This accuracy could be maintained on a given target. The accuracy of anti-aircraft batteries would be reduced to about 70% of normal by use of tracer control. A determined air or surface attack would be fatal to the ship.

(c) Constructive criticism of location and arrangement of stations.

Greater strength of masts and other supporting structure for directors and other fire control instruments is necessary to maintain the operating efficiency of undamaged instruments. Adequate shields or enclosures must also be provided for the protection of the crews from heat and blast.

P. Ammunition Behavior.

(a) Ready service ammunition location, protection, behavior under heat and blast.

Main battery turrets 1, 3, and 5 were in condition "Z" and turrets 2, 4 and 6 were in condition "Y" for the test. AP and HC 12"/50 projectiles were displayed in the gun chambers of turrets 1, 2, 3 and 4 as well as on the upper shell deck of turrets 2 and 3. 12"/50 powder charges were stowed in turret 2. Fuzes were displayed on the upper shell deck of turret 2. All 12" ammunition was undamaged from the Test.

5"/51 H.C., projectiles and powder charges were located in the port and starboard aircastle. There is no evidence of damage to this ammunition.

3"/50 ammunition was stowed in ready service boxes on the superstructure and main decks. Ready service lockers at frame 75 and 101 starboard side on the main deck have the sun shields blown off and all sides dished in from the blast. Ten of the twenty-four rounds have crumpled cases from deformation of the locker sides. These

rounds would probably cause plug casualties if they were fired. The remaining fourteen rounds are not damaged. Lockers on the port side of the superstructure deck level at frame 51 were exposed to heat from burning U.S. Army equipment. The paint on the lockers is blistered but the ammunition is not damaged. A maximum temperature of 125 degrees was recorded with the locker. There is no other damage to 3"/50 ready service ammunition.

40MM and 20MM ammunition was stowed in lockers on the main deck, boat deck and on the signal bridge. One 20MM ready service box at frame 75 starboard on the main deck is damaged from the blast. The sun shield is ripped off and the sides are dished in. The ammunition is not damaged. This ready service box contained 360 rounds not in magazines. Had this ammunition been in magazines about 50% of the magazines would have been damaged. Penetration of heat within these boxes was negligible.

(b) Magazines, location, protection, forces involved, behavior.

All below decks ammunition stowages are normal.

(c) List of stowages which are insufficiently protected, and effect on ship survival of explosion of each stowage.

All below decks stowages are sufficiently protected.

Q. Ammunition Handling.

(a) Condition and operability of ammunition handling devices.

No damage.

(b) Evidence that any ammunition handling devices contributed to passing heat, fire, blast or flooding water.

There is no conclusive evidence that ammunition handling devices contributed to the passing of heat, fire, blast or flooding water. The difference in the average temperature during the test, was not any greater in the lower handling room of turrets that were in

condition "Y" than those in the lower handling rooms of turrets that were in condition "Z". There was a slight variation which was to be expected due to closing down of the ventilation systems.

(c) Constructive criticism of design and construction of ammunition handling devices.

No comment.

R. Strength.

(a) Permanent hog or sag.

There is no evidence of permanent hog or sag.

(b) Sheer strains in hull plating.

There are no apparent shear strains in hull plating.

(c) Evidences of transverse or racking strains.

There is no evidence of racking strains.

(d) Details of any local failures in way of structural discontinuities.

The weather deck was pulled away from the barbette under high deck loading.

(e) Evidence of panel deflection under blast.

The main deck has suffered a major panel failure just aft of turret 6. The deflection extends from about frame 115 to frame 130 and reaches a maximum depression of about two feet at frame 125. Discontinuities affecting the deflection are barbette 6, two access hatches, and four large ventilation intakes.

The weather deck forward has uneven wave deflections which are influenced by supporting stanchions placed under heavy U.S. Army equipment.

The starboard blister and shell plating is dished severely above the waterline aft of frame 70.

The mainmast is moved forward and to port. The starboard tripod leg is pulled free of the main and second decks. The port tripod leg is bent and crushed about six feet above the main deck level. The foreleg is bent and crushed in compression about five feet above the main deck and bulkheads below the footing of the foreleg are buckled.

(f) Turret, machinery and gun foundations.

Turret, main machinery, and gun foundations are apparently undamaged. Movement of the mainmast has caused misalignment of all directors and other fire control equipment in this structure.

S. Miscellaneous.

No comment.

TECHNICAL INSPECTION REPORT

SECTION II - MACHINERY

GENERAL SUMMARY OF MACHINERY DAMAGE

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

No data taken by machinery group.

(b) Structural damage.

The stack was torn away at its base and fell over to port in such a position as to completely block the gas passage from the uptakes. The upper part of the uptakes were distorted by the carrying away of the stack. The port crane was moderately damaged and the starboard crane severely damaged structurally. Deflection of the main deck aft caused severe damage to the after deck winch. One boat went overboard. Structural damage to decks and bulkheads crushed the butcher shop equipment and caused minor damage to galley equipment.

(c) Damage; machinery and ship control.

Boilers 3 and 4 were considerably damaged, #2 lightly damaged. All significant damage to boilers was to casing panels, which were blown out and in some cases ruptured. The after deck winch was severely damaged and is considered to be beyond repair. The port crane was considerably damaged. This damage was largely structural but there was some damage to hydraulic machinery of this unit. The starboard crane rotating platform was thrown off its rollers, platform cracked, and gear crane housing blown off. One motor whaleboat was blown overboard. On the other boat, the muffler exhaust pipe and battery lugs were broken off. The auxiliary exhaust steam line was cracked in two places in the engine room. Butcher shop equipment was demolished. There was minor damage to galley equipment.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Paint on exposed surfaces was charred and blistered. Otherwise, there is no evidence of heat in machinery spaces or on exposed machinery.

(b) Fires and explosions.

There is no evidence of fires or explosions in machinery spaces or on exposed machinery.

(c) Shock.

There is no evidence of shock.

(d) Pressure.

All major damage to the machinery installation was caused by blast pressure or by deflection of decks and bulkheads which was caused by blast pressure. Minor damage is believed to have been caused by the whipping motion of the ship following the blast. The blast apparently came from slightly aft of the starboard beam.

(e) Any effects apparently peculiar to the Atom Bomb.

A blast pressure of this magnitude is believed to be peculiar to the Atom Bomb.

III. Effects of Damage.

(a) Effect on machinery and ship control.

All steam power was lost. The after deck winch and butcher shop equipment are beyond repair. The cranes require major repairs, although emergency repairs to the port crane to make it temporarily operable could be made by the ship's force. The engine of the one remaining motor whaleboat could be repaired by the ship's force if

spare parts were available. All other damage to machinery is minor and could be easily repaired by the ship's force. It is estimated that the ship's force require at least 4 days to make temporary repairs to enable the ship to steam at slow speed. It is estimated that approximately 45 working days at a shipyard would be required to restore the ship to normal operating conditions. The effect on ship control from a machinery viewpoint was to limit power to that furnished by the two (100 Kw) emergency diesel generators.

(b) Effect on gunnery and fire control.

No comment.

(c) Effect on watertight integrity and stability.

No comment.

(d) Effect on personnel and habitability.

It is estimated that there would have been a high percentage of casualties in the after fireroom and some casualties in the forward fireroom if the ship had been steaming at the time of the test. It is not believed that there would have been any other personnel casualties below decks, although casualties among exposed personnel would have been high. Habitability is reduced by loss of steam power, and to a minor extent by damage to galley and butcher shop equipment.

(e) Total effect on fighting efficiency.

The ship is immobilized and is no longer an effective fighting unit. It is estimated that 45 working days at a shipyard would be required to restore her machinery to normal operating condition.

IV. General Summary of Observers' Impressions and Conclusions.

It is not believed that a modern battleship, exposed to a similar attack at the range of the ARKANSAS would have been immobilized, although some damage to boilers would probably have occurred.

The stacks of the ARKANSAS would probably not have carried away if it had been in good condition, although it would undoubtedly have been damaged. The ARKANSAS's stack was severely corroded before Test A.

V. Preliminary Recommendations.

Stacks and boiler casings should be made more resistant to blast pressure.

Steps should be taken to insure that stacks of all vessels are inspected and repaired to preserve their original strength.

DETAILED DESCRIPTION OF MACHINERY DAMAGE

A. General Description of Machinery Damage.

(a) Overall condition.

The stack was severed from the ship's structure at its base and fell over to port, carrying with it the whistle and siren, their piping, and the atmospheric exhaust pipe. The stack fell in a position which blocked the gas passage from the uptakes and made steaming impossible. All boilers were damaged sufficiently to make them inoperable, boilers #3 and #4 considerably worse than boilers #1 and #2. The after deck winch was damaged beyond repair, the deck beneath it having collapsed. The port crane was considerably damaged but could be repaired to make it operable. The starboard crane was severely damaged, largely structurally, and would require major repairs. The auxiliary steam line in the engine rooms had two cracks, these could be readily repaired. There was considerable damage to equipment in the galley and butcher shop. One boat was blown overboard, the engine of the other was severely damaged. There was minor damage to galley equipment. Butcher shop equipment was demolished by material falling on it from overhead when the deck above it was deflected.

( ) Areas of major damage.

Major damage to machinery occurred only where the direct effects of the blast could reach the machinery, or where deflection of decks and bulkheads by the blast damaged machinery. These areas were: stacks, uptakes, boilers, cranes, after deck winch, and boats.

(c) Primary cause of damage.

Air blast or structural failures incident to air blast caused all major damage to machinery. Cracks in the auxiliary exhaust line in the engine rooms were apparently caused by the whipping motion of the ship following the blast.

(d) Effect of target test on overall operation of machinery plant.

All steam power was lost. One boiler could be steamed after the test. However, falling of the stack and its position after falling would have made steaming impossible until part of the stack was cut away and a temporary stack rigged. It is estimated that temporary repairs to enable the ship to steam at slow speed on two boilers would have required at least 4 days. Power was limited to that furnished by the two (100 Kw) emergency Diesel generators. Emergency repairs to the port crane, auxiliary exhaust line, and galley could be made by the ship's force in a few hours. The after deck winch, starboard crane, and butcher shop equipment could not be repaired by the ship's force.

B. Boilers.

(a) Casings.

There was slight damage to boilers #1 and #2, forward fireroom. Damage was heavier to boilers #3 and #4 in the after fireroom. Of the two boilers in the forward fireroom, #1 boiler had the least damage. The casings of this boiler show very little distortion and there are no ruptures or failures at the panel joints. This boiler could be steamed after the test. The casings of #2 boiler are in generally good condition on the front, rear, and inboard side. Little distortion and no ruptures or failures occurred.

The outboard casing of #2 boiler was dished in at horizontal panels immediately above the vertical portion of the side casing. Failure was at the panel joint. The bolts pulled through the sheet which formed the joint flanges, enlarging the holes. This type of failure is typical on boiler casings of this vessel. This boiler was inoperable after the test but temporary repairs could be made by the ship's force within a few hours.

The casings of boilers #3 and #4 were damaged to a greater extent than those of boilers #1 and #2. (See Photos 1876-5, 6, 7, and 8; pages 157, 158, 159 and 160). The side casings around

the mud drum of boiler #3 were blown out. (See Photos 1876-3 and 4; pages 161 and 162). The horizontal casing panels immediately above the vertical casing panels of this boiler were dished. This dishing reached a maximum of 10 inches on the starboard side and 8 inches on the port side. The vertical panels of boiler #3 remained in place.

The upper side casings of boiler #4 were dished similarly to those of boiler #3 but only about 4 inches. The vertical panels of boiler #4 blew out. There were failures at panel joints similar to those described above for boiler #2.

(b) External fittings.

A visual examination of external fittings was made and no apparent damage was observed. Hydrostatic tests indicate that no damage was sustained by the pressure parts of the boilers.

(c) Fuel oil burners.

Damage to fuel oil burners was light and was confined to the air doors. All oil connections and valves are operable. Most air doors are in operating condition. In a few cases the air door flaps are bent. They could be easily straightened by the ship's force.

(d) Brickwork and furnaces.

The brickwork and furnaces of all boilers are practically undamaged. There are some minor cracks in the front and rear walls. One or two bricks which form a corbel between the front wall and the tubes fell down. No significant motion of front or rear wall with relation to side walls has occurred.

(e) Drums and headers.

No apparent damage.

(f) Tubes.

The tubes have suffered no apparent damage.

(g) Foundations.

The foundations of all boilers are intact.

(h) Stacks and uptakes.

The stack was completely torn away from the ship's structure. (See Photos 1876-9 and 10; 1897-1,2, 3, 6, 7, and 8; pages 163, 164, 165, 166, 167, 57, 56, and 60). The flanges where the stack joins the uptake pulled apart and the stack fell over to port. The starboard side was crushed in until the smoke pipe was almost pinched off. Uptakes and division plates immediately below the point of failure are distorted and buckled, apparently from the effect of the stack being carried away. Below this point, the uptakes are undamaged.

Stack connections failed due to the bolts being torn through the sheet. There were tears at the diameters of the holes and tangential to the diameter. All sheet was severely rusted and the strength, therefore, was greatly reduced before Test A.

NOTE: After Test A, temporary repairs were made which permitted one boiler to be lighted off, steam to be raised, and machinery to be tested. (See Photos 1882-12, 2091-8, and 2095-8; pages 168, 169, and 170).

C. BLOWERS.

Undamaged. All blowers have been tested as follows:

Blowers 1 to 4 inclusive at 1500 rpm and 7 inches of water pressure.

Blowers 5 to 8 inclusive at 1500 rpm. No pressure readings were taken.

D. FUEL OIL EQUIPMENT.

Undamaged. The fuel oil system was tested and operated after Test A, and functioned normally.

E. BOILER FEEDWATER EQUIPMENT.

Undamaged. The entire system was tested and operated after Test A, and functioned normally.

F. MAIN TURBINES.

Undamaged. All four turbine units were turned over by jacking gear and steam. All the units functioned normally.

Leads left in the bearings of the main turbine rotors indicate slight movement of the rotors, not exceeding .017 inch in any case.

BEARING LEAD DATA

STARBOARD ENGINE H.P. AHEAD TURBINE - FORWARD

BEARING;

No. 1 Lead	Before Test A	After Test A	Difference
Port	.013	.012	.001
Top	.012	.0105	.0015
Stbd	.012	.0075	.0045
No. 2 Lead			
Port	.014	.0095	.0045
Top	.011	.0085	.0025
Stbd	.012	.009	.003
No. 3 Lead			
Port	.010	.0065	.0035
Top	.010	.0065	.0035
Stbd	.010	.007	.003

STARBOARD ENGINE I.P. AHEAD TURBINE - FORWARD BEARING

No. 1 Lead	Before Test A	After Test A	Difference
Port	.016	.0115	.0045
Top	.028	.015	.013
Stbd	.027	.0215	.0055
No. 2 Lead			
Port	.0145	.0105	.004
Top	.031	.014	.017
Stbd	.022	.014	.008
No. 3 Lead			
Port	.018	.010	.008
Top	.029	.017	.012
Stbd	.013	.011	.002
No. 4 Lead			
Port	.017	.011	.006
Top	.0275	.0175	.010
Stbd	.019	.013	.006

STARBOARD ENGINE L.P. AHEAD TURBINE - FORWARD BEARING

No. 1 Lead			
Port	.015	.0135	.0015
Top	.0305	.029	.0015
Stbd	.016	.017	+.001
No. 2 Lead			
Port	.014	.0105	.0035
Top	.030	.028	.002
Stbd	.014	.012	.002

STARBOARD ENGINE L.P. AHEAD TURBINE - FORWARD BEARING

No. 3 Lead	Before Test A	After Test A	Difference
Port	.0115	.013	+.0015
Top	.039	.025	.014
Stbd	.015	.0115	.0035
No. 4 Lead			
Port	.014	.013	.001
Top	.033	.0195	.0135
Stbd	.016	.0145	.0015
No. 5 Lead			
Port	.021	.013	.008
Top	.037	.0025	.0145
Stbd	.016	.010	.006

PORT ENGINE H.P. AHEAD TURBINE - FORWARD BEARING

No. 1 Lead			
Port	.008	.007	.001
Top	.015	.011	.004
Stbd	.008	.006	.002
No. 2 Lead			
Port	.012	.009	.003
Top	.014	.014	.000
Stbd	.011	.008	.003
No. 3 Lead			
Port	.012	.009	.003
Top	.015	.013	.002
Stbd	.013	.007	.006

PORT ENGINE I. P. AHEAD TURBINE - FORWARD BEARING

No. 1 Lead	Before Test A	After Test A	Difference
Port	.011	.010	.001
Top	.015	.007	.008
Stbd	.015	.008	.001
No. 2 Lead			
Port	.009	.007	.002
Top	.017	.012	.005
Stbd	.009	.006	.003
No. 3 Lead			
Port	.011	.007	.004
Top	.018	.013	.005
Stbd	.011	.018	+.007

PORT ENGINE L. P. AHEAD TURBINE - FORWARD BEARING

No. 1 Lead			
Port	.010	.009	.001
Top	.027	.017	.010
Stbd	.018	.012	.006
No. 2 Lead			
Port	.014	.011	.003
Top	.023	.012	.011
Stbd	.017	.010	.007
No. 3 Lead			
Port	.013	.010	.003
Top	.025	.014	.011
Stbd	.013	.008	.005

PORT ENGINE L.P. AHEAD TURBINE - FORWARD BEARING

No. 4 Lead	Before Test A	After Test A	Difference
Port	.012	.008	.004
Top	.025	.014	.011
Stbd	.016	.009	.007
No. 5 Lead			
Port	.011	.008	.003
Top	.028	.017	.011
Stbd	.013	.008	.005

G. REDUCTION GEARS.

Undamaged. Reduction gears were jacked over and the teeth were inspected. The units were also turned over with steam power, ahead and astern. Performance was normal.

H. SHAFTING AND BEARINGS.

Undamaged. All shafts were turned over and performed normally.

I. LUBRICATION SYSTEM.

Undamaged. The lube oil system was tested and operated at designed pressures, and functioned normally.

J. CONDENSERS AND AIR EJECTORS.

Undamaged. Both main and auxiliary condensers were tested and operated at 28 and 26 inches vacuum, respectively. The rado-jets, air ejectors and air pumps were also tested and operated. Performance of all units was normal.

K. PUMPS.

Undamaged. All pumps were tested and operated at designed pressure after Test A, and functioned normally.

L. AUXILIARY GENERATORS.

Undamaged. All four turbo-generators were tested and operated after Test A, and functioned normally.

M. PROPELLERS.

Undamaged. There was no evidence of any damage while turning over the main engines after Test A. Propellers were not inspected visually.

N. DISTILLING PLANT.

Undamaged. The two 20,000 gallon per day and the emergency 8,000 gallon per day evaporating plants were tested and operated after Test A. The quantity and quality of water is the same as before Test A.

O. REFRIGERATING PLANT.

Undamaged. The refrigerating plant was placed in operation as soon as power became available after Test A, and functioned normally.

P. WINCHES, WINDLASSES, AND CAPSTANS.

The after deck winch was made inoperable by the sagging of the main deck underneath it, which is about three feet below normal. This sagging resulted in the following damage: Bedplate cracked athwartship, brake lever bearing is cracked, gear case cracked, inboard bearing pedestal on starboard side cracked, starboard shaft bent and pulled loose from coupling. The derangement is shown on Photo #2168-3, page 171. All other equipment included in this item is undamaged and was operated under service conditions after Test A.

Q. STEERING ENGINE.

Undamaged. The steering engine was tested at full throw, 35° left to 35° right, five times after Test A, and functioned normally.

R. ELEVATORS, AMMUNITION HOISTS, ETC.

(a) Airplane crane (port).

The machinery of the port crane appeared to be in operable condition, however, oil leaked from around the Waterbury "A" end shaft when operation was attempted. A new shaft seal was installed and the power unit of the cranewas then operated successfully. In addition, the vent liner to the expansion tank was badly twisted and bent. Hand railing was bent. The housing for the rotating gear was torn off. The locking pin lug was torn loose from rotating platform as if the entire structure had attempted to rotate counter-clockwise. The wire rope was crushed in places.

(b) Airplane crane (starboard).

This crane was heavily damaged and is probably beyond repair. The rotating platform was thrown off its rollers and raised about 8 inches on the outboard side. The platform itself is cracked on the forward edge. The gear train housing was blown off and is missing. This derangement is shown on photographs #1882-10 and 11, 2096-1, and 1775-10; pages 172, 173, 174, and 58 .

(c) The ammunition hoists under the cognizance of the Bureau of Ships are undamaged and were operated normally after Test A.

S. VENTILATION (MACHINERY).

Undamaged. All ventilation machinery was tested and operated normally after Test A.

T. AIR COMPRESSORS.

Undamaged. The four Westinghouse steam driven single stage air compressors and the one motor driven air compressor were all tested and operated after Test A and functioned normally.

U. DIESELS.

The two emergency diesel generators are undamaged. Both were operated under service conditions after Test A and functioned normally.

One motor whaleboat was blown overboard. The diesel engine of the other was severely damaged. The muffler and exhaust pipe were knocked off, starting battery lugs were knocked off and considerable minor damage done.

V. PIPING.

The piping sustained no damage due to Test A except as noted below. Undamaged piping was tested at normal operating pressure after Test A.

(a) Main steam.

No damage.

(b) Auxiliary steam.

The whistle and siren and piping to them, and the atmospheric exhaust line, were carried away with the stack. Otherwise, the auxiliary steam line was undamaged.

(c) Auxiliary exhaust.

The exhaust line from the circulating pump, starboard engine room, has a crack about 5 inches long. This could be easily repaired by the ship's force. The exhaust main running athwartship through the fore and aft bulkhead in the engine room has a crack about 2 inches long adjacent to the bulkhead. The bulkhead directly

above this pipe was slightly distorted and several rivets were sheared off. It is believed that this bulkhead failure caused the break in the pipe. This could have been easily repaired by the ship's force.

A 1 1/2 inch I.P.S. silver soldered fitting in the emergency overboard line from the air ejector condenser, starboard main evaporator was found leaking.

(d) Condensate and feedwater.

No damage.

(e) Fuel oil system.

No damage.

(f) Lube oil system.

No damage.

(g) Firemain.

No damage.

(h) Condenser circulating water.

No damage.

(i) Drains.

No damage.

(j) Compressed air.

No damage.

(k) Hydraulic.

Not inspected.

(1) Gasoline.

No damage.

W. MISCELLANEOUS.

(a) Galley.

Many short nipples in the piping were broken. There were a large number of leaks in the steam piping but all damage to the piping in the galley due to Test A was quickly restored to operable condition by the ship's force. One steam kettle was damaged by the after bulkhead of the galley coming in against it, causing severe leaks.

(b) Machine shop.

No damage.

(c) Laundry.

No damage.

(d) Butcher shop.

Completely demolished by falling material.

(e) Whistle and siren.

The whistle and siren were displaced when the stack fell over, however, specific damage to the whistle and siren was not observed.

TECHNICAL INSPECTION REPORT

SECTION III - ELECTRICAL

GENERAL SUMMARY OF ELECTRICAL DAMAGE

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

Drafts not noted . No flooding occurred due to blast.

(b) Structural damage.

Electrical damage occurred in areas as indicated below.

1. Both masts.
2. Main deck aft.
3. Second deck aft.
4. Superstructure forward and aft.

(c) Other damage.

Damage to electrical equipment in general was of a minor nature. Operability remained essentially the same as before Test A, except those damaged as listed below.

1. Two 36", one 24", and four 12" searchlights.
2. Running and signal lights.
3. After deck winch.
4. Four vent sets.
5. Two master gyro compasses.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Radiant heat scorched the paint on electrical equipment exposed directly to the blast. Some cables on the foremast were affected to the extent that beads of insulation protruded through the armor.

(b) Fires and explosions.

1. Damage by fire to electrical equipment was negligible. One 12" signal searchlight had its portable cable burned by fire on bridge wing.

2. No explosion occurred.

(c) Shock.

No damage to electrical equipment occurred that can be attributed directly to shock. Electrical damage attributed indirectly to shock at time of structural failures are as follows:

1. The after warping winch control resistance was broken.

2. Portable batteries jumped out of their racks.

3. The overload relay spring for doughmixer popped out of place.

(d) Pressure.

The blast pressure wave came from about 125° relative. Electrical damage attributed to pressures are as follows:

1. The after warping winch made inoperable when deck support gave away.

2. All searchlights except three 12" signal lights on the port wind of the bridge are damaged and inoperable.

3. Some cables were damaged by structural failure.

4. The vertical fighting lights, running lights and anchor lights were inoperable due to structural failures flying object and open circuits.

5. Ventilating motor impellers were bent due to pressure in impeller housings.

(e) Any effects apparently peculiar to the atom bomb.

No effects to electrical equipment peculiar to the atom bomb occurred.

III. Effects of Damage.

(a) Effect on propulsion and ship control.

Effect on electrical equipment was negligible. Ship control was not affected, emergency diesel generators were both operable. With the return of steam the main turbo-generator was operable. Both master gyros were operable on replacing mercury that had spilled.

(b) Effect on gunnery and fire control.

Effect of electrical damage to gunnery was negligible. Effect of electrical damage to fire control was negligible.

(c) Effect on water-tight integrity and stability.

Electrical equipment had no effect.

(d) Effect on personnel and habitability.

Electrical effect was negligible. Confined entirely to damage to ventilation such as impeller housings.

(e) Total effect on fighting efficiency.

Electrical effect on fighting efficiency would have been negligible.

IV. General Summary of Observers' Impressions and Conclusions.

1. No electrical damage to ship's service generating plant occurred.

2. Interior communications had slight disruption mainly on distorted superstructures.

3. Electrical damaged to ventilation was negligible.

4. Searchlights received the major part of electrical damage.

5. In general electrical damage had no major effect on this ship.

V. Any Preliminary General or Specific Recommendations of the Inspecting Group.

Specific recommendations are given in part C for each item where applicable.

DETAILED DESCRIPTION OF ELECTRICAL DAMAGE

A. General Description of Electrical Damage.

(a) Overall condition.

The overall condition of the electric plant after Test A was essentially the same as before the test except for the following:

1. Searchlights were badly damaged.
2. Running and signal lights were badly damaged.
3. After deck winch was damaged.
4. Four vent sets were damaged.
5. The two master gyro compasses spilled mercury.

(b) Areas of major damage.

1. Masts and superstructures.
2. 2nd deck aft.

(c) Primary causes of damage in each area of major damage.

1. Masts and superstructure, damage was due to blast.
2. 2nd deck aft, damage was due to distortion of deck above.

(d) Effect of target test on overall operation of electric plant.

1. Ship's service generator plant - no effect.
2. Engine and boiler auxiliaries - no effect.
3. Electric propulsion - not applicable.
4. Communications - searchlights and signal lights severely damaged. Interior communication not appreciably affected.
5. Fire control circuits. Considerable damage was sustained to topside wiring to guns and directors due to distortion of structural supports. Circuits to main battery turrets and circuits below the main deck were undamaged.

6. Ventilation. Electrical damage to the ventilation systems was slight. Two controllers and four motors were damaged due to distortion of supporting structure.
7. Lighting. Light fixtures and bulbs throughout the vessel were undamaged, except in way of structural damage and from flying objects.

(e) Types of equipment most affected.

1. Searchlights - damaged by blast.
2. Signalling lights - damaged by blast or flying objects.

B. Electric Propulsion Rotating Equipment.

Not Applicable.

C. Electric Propulsion Control Equipment.

Not Applicable.

D. Generators - Ships Service.

No damage due to test.

E. Generators - Emergency.

No damage due to test.

F. Switchboards, Distribution and Transfer Panels.

No damage due to test.

G. Wiring, Wiring Equipment and Wireways.

(a) Cable, wireways, and wiring equipment below the main deck were generally undamaged except a few isolated cables in way of hull structural failures. A few cables on the superstructure and masts

were ruptured and displaced due to distortion and parting of structural members. Exposed painted cables in way of the heat blast had paint scorched off. A few unpainted cables on the foremast showed beads of insulation outside the armor due to the heat radiation. Ref. photos. 1895-11, 2094-12, 2135-4,5,6; pages 86, 44 , 32, 176, and 29.

(b) Wireways and supports were generally undamaged except in way of ruptured or distorted hull structure. Wireways up starboard side of foremast at air defense platform had cable blasted to one side of the rack and several straps broken. Cable was loose in hangars but serviceable. Ref. photos. 2094-2,5; pages 33 and 34 .

(c) Connection boxes, junction boxes, receptacles and plugs were undamaged except where hit by other objects. Ref. photos. 2097-2, page 111.

H. Transformers.

No damage due to test.

I. Submarine Propelling Batteries.

Not applicable.

J. Portable Batteries.

(a) A number of batteries in the battery locker were damaged due to jumping off the stowage rack.

(b) Batteries in motor boats were damaged due to jumping out of securing locker.

(c) Other batteries were undamaged. No damage was noted to batteries which were well secured.

K. Motors, Motor Generator Sets and Motor Controllers.

(a) Motors and controllers throughout the vessel were undamaged except as follows.

1. Four vent motors had shafts slightly bent due to deformation of supporting structure.

2. The after deck winch motor pedestal bearing was cracked. Ref. photo. 2168-3, page 171.

3. The after deck winch controller was crushed and grids for controllers broken due to distortion of the deck overhead and distortion of supporting structures. Ref. photo. 2156-4, page 174.

4. Overload relay spring of dough mixer controller jumped out of place from shock due to distortion of the supporting structure.

5. Two vent controller enclosures damaged due to distortion of supporting structure. Controller mechanism was undamaged.

L. Lighting Equipment.

(a) Signal lights and running lights were practically all out of commission due to being carried away by the blast or damaged by being hit by other objects. The fixtures generally were not damaged by blast or shock.

(b) Lighting throughout the ship other than running lights and signal lights was generally not damaged. This applies to fluorescent fixtures as well as to incandescent types. A few bulbs and fixtures were damaged by impact of structure or flying articles.

M. Searchlights.

(a) The starboard 36'' searchlight was blown from platform. Both yokes were broken off near the base. The drum and mechanism were wrecked due to dropping to the deck below. Ref. photo. 1895-4; page 177.

(b) The port 36" searchlight has the front door glass and shutter broken from flying objects or blast. Otherwise operable.

(c) The starboard 24" searchlight on foremast had both yokes broken by blast. The drum was dished in and glass door broken. Incandescent bulb, (1000 W) was not broken.

(d) The eight 12" lights installed were in the following condition:

1. Two on mainmast had supporting brackets cracked and bent, barrels dished in and lamp filaments broken. Shutters were operable.

2. Three on signal bridge port were not damaged.

3. Two lights on signal bridge, starboard, were damaged by impact. One light was undamaged except that portable cable was burned by fire originating in flag material on deck.

N. Degaussing Equipment.

No damage noted except to compensating coils on magnetic compass which were damaged when compass was thrown from its stand to the deck below.

O. Gyro Compass Equipment.

(a) The forward master-gyro compass spilled approximately 3 lbs. of mercury and the after gyro compass spilled a few drops. Master-gyros were otherwise undamaged.

(b) Two gyro compass repeaters were damaged. The repeater in Battle II (mainmast) had the dial glass broken, and the dial bent and the internal wiring deranged so as to cause a zero ground. They gyro compass repeater in the secondary control station forward came adrift from its mounting but was otherwise undamaged.

P. Sound Powered Telephones.

No damage noted to hand sets or head sets. Selector switch housings on panel at forward AA defense station were broken due to supporting panel blowing down onto the deck. The method of securing the panel was faulty. The panel was large with considerable heavy equipment mounted on it. Ref. photo. 2094-2; page 33

Recommendations.

Where telephone and other instruments must be installed in exposed locations, only a few instruments should be installed on a single panel. The panel should be so installed as to minimize the effect of the blast.

Q. Ship's Service Telephones.

No damage was noted to any equipment. A few phones were knocked off old style hooks.

R. Announcing Systems.

(a) Enclosure of P.A. transmitter on flying bridge was damaged by a flying object. Operability of the transmitter was not affected.

(b) One P.A. speaker in crew's head and one at frame 115 starboard, second deck had heads knocked from casing. Probably due to defective fastening as no washers were found on the screws.

S. Telegraphs.

No damage due to test.

T. Indicating Systems.

Transmitters for wind direction and intensity system were blown off the mast. No other damage to indicating systems was noted.

U. I.C. and A.C.C. Switchboards.

No damage due to test.

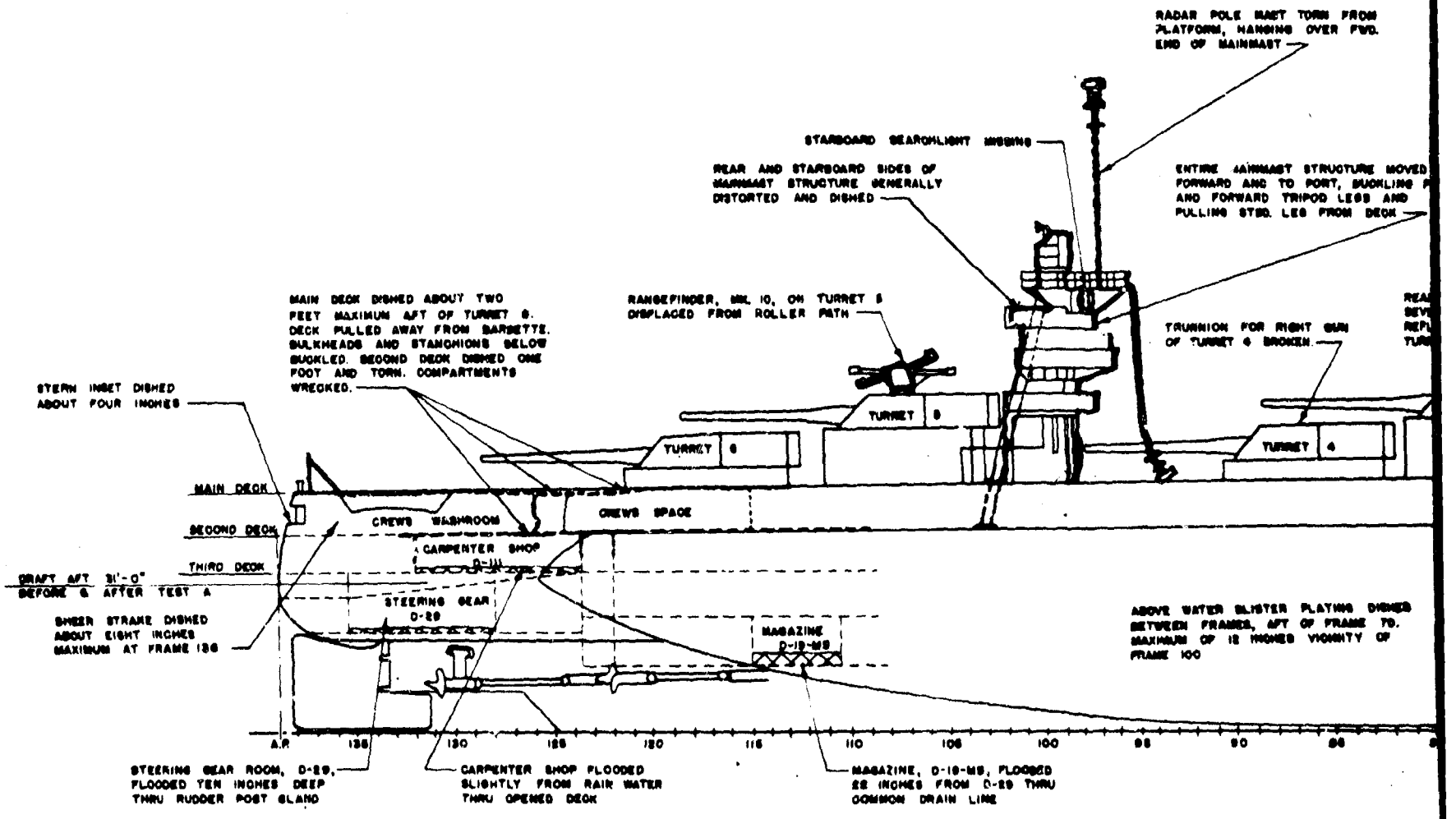
V. F.C. Switchboard.

No damage due to test.

APPENDIX

SHIP DAMAGE DIAGRAM

TEST ABLE


RADAR POLE MAST TORN FROM PLATFORM, HANGING OVER FWD. END OF MAINMAST
STARBOARD SEARCHLIGHT MISSING
REAR AND STARBOARD SIDES OF MAINMAST STRUCTURE GENERALLY DISTORTED AND DISHED
ENTIRE MAINMAST STRUCTURE MOVED FORWARD AND TO PORT, BUCKLING AFT AND FORWARD TRIPOD LEGS AND PULLING STBD. LEG FROM DECK
MAIN DECK DISHED ABOUT TWO FEET MAXIMUM AFT OF TURRET 6. DECK PULLED AWAY FROM BARBETTE. BULKHEADS AND STANCHIONS BELOW BUCKLED. SECOND DECK DISHED ONE FOOT AND TORN. COMPARTMENTS WRECKED.
RANGEFINDER, MK. 10, ON TURRET 5 DISPLACED FROM ROLLER PATH
TRUNNION FOR RIGHT GUN OF TURRET 4 BROKEN
STERN INSET DISHED ABOUT FOUR INCHES
TURRET 5
TURRET 6
TURRET 4
MAIN DECK
SECOND DECK
THIRD DECK
CREWS WASHROOM
CREWS SPACE
CARPENTER SHOP D-11
DRAFT AFT 31'-0" BEFORE & AFTER TEST A
STEERING GEAR D-29
MAGAZINE D-19-MS
SHEER STRAKE DISHED ABOUT EIGHT INCHES MAXIMUM AT FRAME 136
ABOVE WATER BLISTER PLATING DISHED BETWEEN FRAMES, AFT OF FRAME 70. MAXIMUM OF 12 INCHES VICINITY OF FRAME 100
A.P
136
130
125
120
115
110
105
100
95
90
86
STEERING GEAR ROOM, D-29, FLOODED TEN INCHES DEEP THRU RUDDER POST GLAND
CARPENTER SHOP FLOODED SLIGHTLY FROM RAIN WATER THRU OPENED DECK
MAGAZINE, D-19-MS, FLOODED 22 INCHES FROM D-29 THRU COMMON DRAIN LINE
AFTER
SEVERE
HATCH BLOWN OFF
FIRE VENTED WITH
MAIN DECK DEPRESSED TO ABOUT TWO FEET MAXIMUM AFT OF TURRET 6
DECK PULLED AWAY FROM BARBETTE 6
RANGEFINDER UPSET ON ROLLER PATH
136
100
95
STARBOARD SHELL DISHED ABOVE WATERLINE
ENTIRE MAINMAST STRUCTURE MOVED FORWARD AND TO PORT
RIGHT TRUNNION OF TURRET 4 CRACKED

"SG" RADAR MAST COLLAPSED TO PORT AND FORWARD

"SK" AND "FC" RADAR ANTE HAS MISSING

RADAR POLE MAST TORN FROM LATFORM, HANGING OVER FWD. NG OF MAINMAST

RADAR PLATFORM BENT UPWARD

TOP OF MAIN BATTERY CONTROL STATION PUSHED FORWARD

STARBOARD AND AFTER FACES OF SECONDARY BATTERY CONTROL STATION DISHED. WINDOW PILASTERS BLOWN OUT ON STARBOARD SIDE

RANGEFINDER PLATFORM BLOWN UPWARD, TEARING CONNECTIONS TO MAST LEGS

DIRECTOR DOOR DISHED

ENTIRE MAINMAST STRUCTURE MOVED FORWARD AND TO PORT, BUCKLING PORT AND FORWARD TRIPOD LEGS AND PULLING STBD. LEG FROM DECK

STACK BLOWN DOWN TO PORT AND RIPPED FROM UPTAKES

AIRCASTLE GUN PORT COVERS DAMAGED BY BLAST

STBD. CRANE INOPERABLE, TOP SHIELD DISHED. PORT CRANE SHIELD ALSO DISHED

REAR FACE OF DECKHOUSE SEVERELY DISHED BY BLAST REFLECTED ALONG SIDE OF TURRET 3

RANGEFINDER, MK. 10, ON TURRET 2 BLOWN DOWN TO MAIN DECK, STARBOARD SIDE

RUNNION FOR RIGHT GUN F TURRET 4 BROKEN.

TURRET 4

TURRET 3

TURRET 2

TURRET 1

OVERHANG BLOWN UPWARD AND DECKHOUSE SIDES SEVERELY DISHED

WATER BLISTER PLATING DISHED N FRAMES, AFT OF FRAME 70. H OF 12 INCHES VICINITY OF 100

90 85 80 75 70 65 60 55 50 45 40 35 30 25 20

DECKHOUSE SIDE DISHED

STACK BLOWN OVER TO PORT

SUPERSTRUCTURE DECK DAMAGED BY FIRE IN TEST EQUIPMENT

AFTER FACE OF TOWER SEVERELY DISTORTED

UPPER PORTION OF FOREMAST DAMAGED BY BLAST

HATCH BLOWN OFF, FIRE IGNITED WITHIN

LER PATH

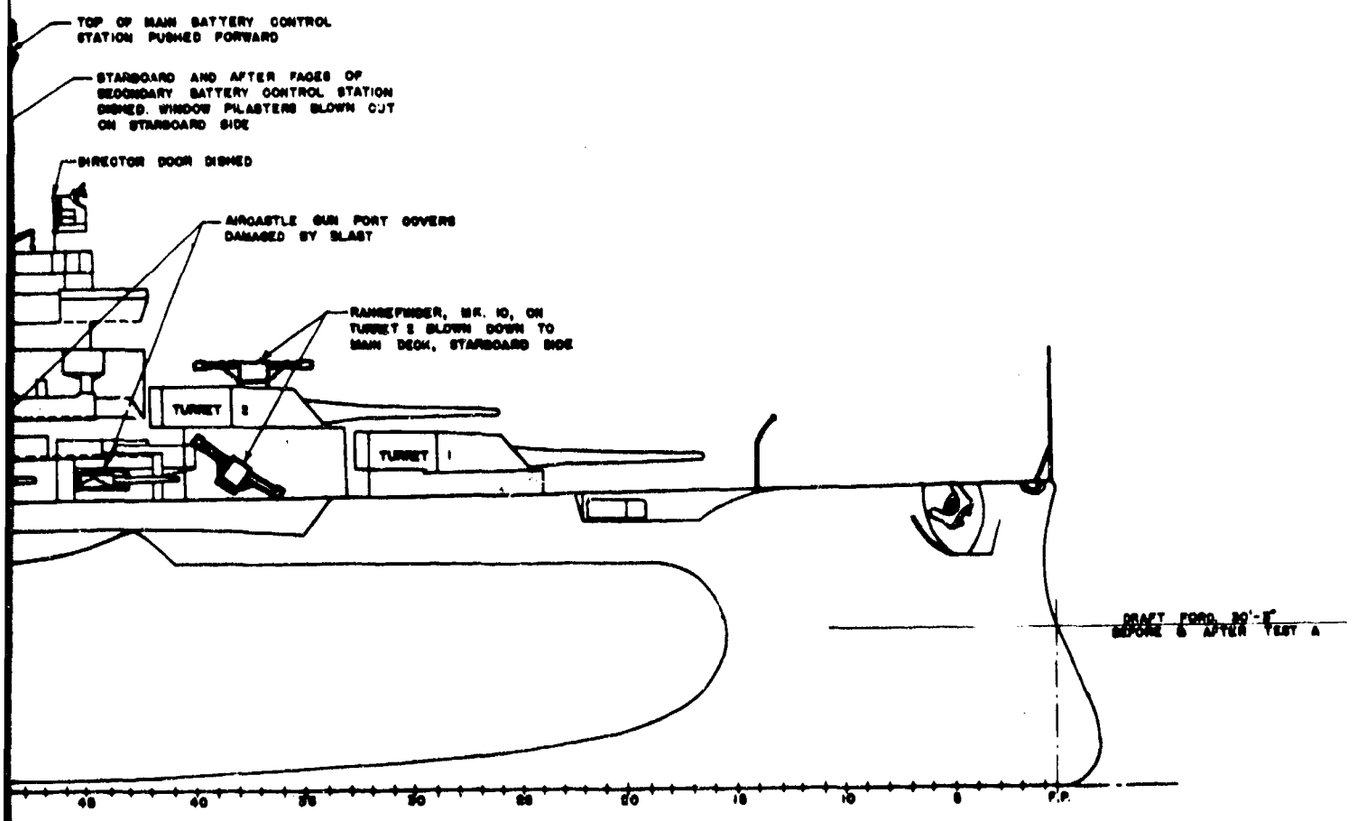
RANGEFINDER BLOWN DOWN TO MAIN DECK

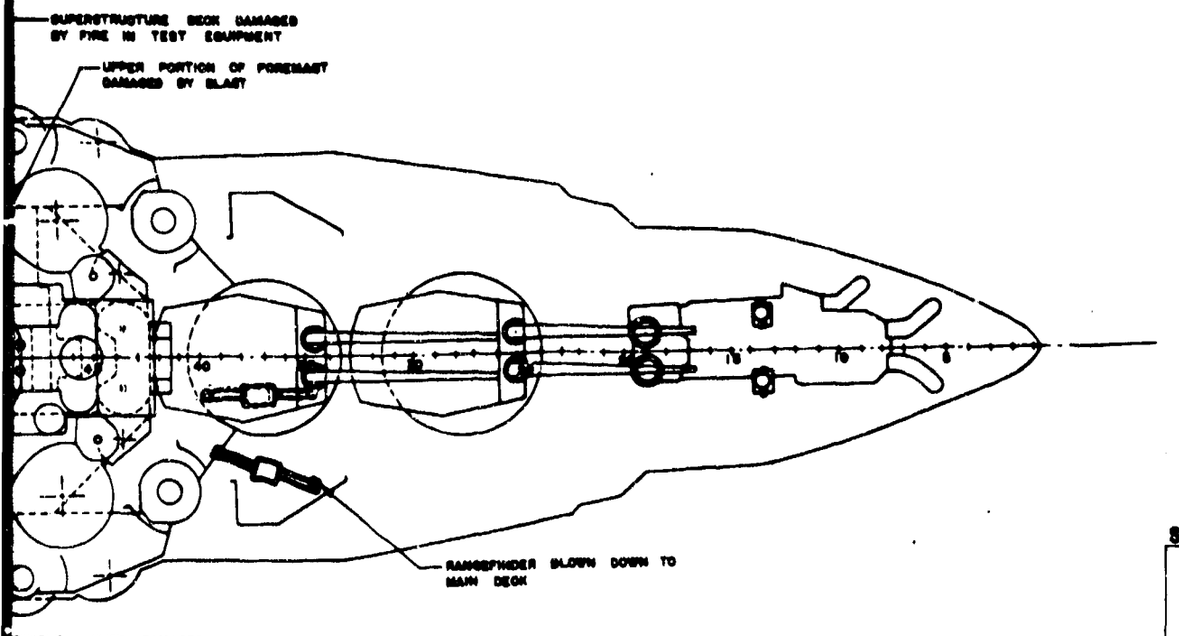
TRUNNION OF TURRET 4

OVERHANGING PLATFORM BLOWN UPWARD AND DECKHOUSE SIDE DISHED

SUPERSTRUCTURE DECK DAMAGED BY FIRE IN ARMY EQUIPMENT

AND "FC" RADAR ANTENNAE MISSING





LEGEND

FIRE

DECK DEFLECTION

SLOW FLOODING

SECRET

NAVY DEPT. BUREAU OF SHIPS

DAMAGE TEST A

U.S.S. ARKANSAS BB 33

APPENDIX

SHIP MEASUREMENT DATA

TEST ABLE

APPENDIX TEST A

SHIP MEASUREMENT DATA

A. General Considerations.

A deck survey method was developed to determine the twist and longifudinal bending of each target vessel's hull girder resulting from an air or underwater burst of the atomic bomb. The procedure is as follows:=

1. Select transverse sections. The maximum number of transverse sections used on any ship was six.

2. At each transverse section, select stations at which rod readings are to be taken. Center punch these stations in the deck. A minimum of five stations were used at each transverse section.

3. Establish throughout the length of the ship, by use of a surveyor's transit, a reference plane approximately parallel to the deck.

4. Take rod readings at every station on each transverse section.

5. Plot rod readings relative to a straight line representing the reference plane.

(a) Readings at each transverse section are plotted in order to obtain the configurations of individual sections and also to establish the relationship between sections.

(b) Readings at desired distances from the centerline are plotted in order to establish sheer lines. On most ships the actual readings are corrected for changes in sections resulting from local damaged.

6. Repeat steps 3, 4 and 5 after the test using the stations established in steps 1 and 2.

7. Superimpose the after test plots on the before test plots in order to compare the conditions existing at the times of the two surveys.

The reference planes used in the before test and after test surveys are not necessarily parallel. Their relationship can not be accurately determined because bench marks established before the test may be affected by local damage or by changes in hull alignment. Therefore it is possible only to determine relative movement of any one section. The reference planes are disregarded after completion of the initial plots.

Twist of the hull girder is determined by superimposing one after test transverse section on the similar before test section and comparing the configurations of the remaining sections. Hog or sag is determined by superimposing before and after test plots of sheer.

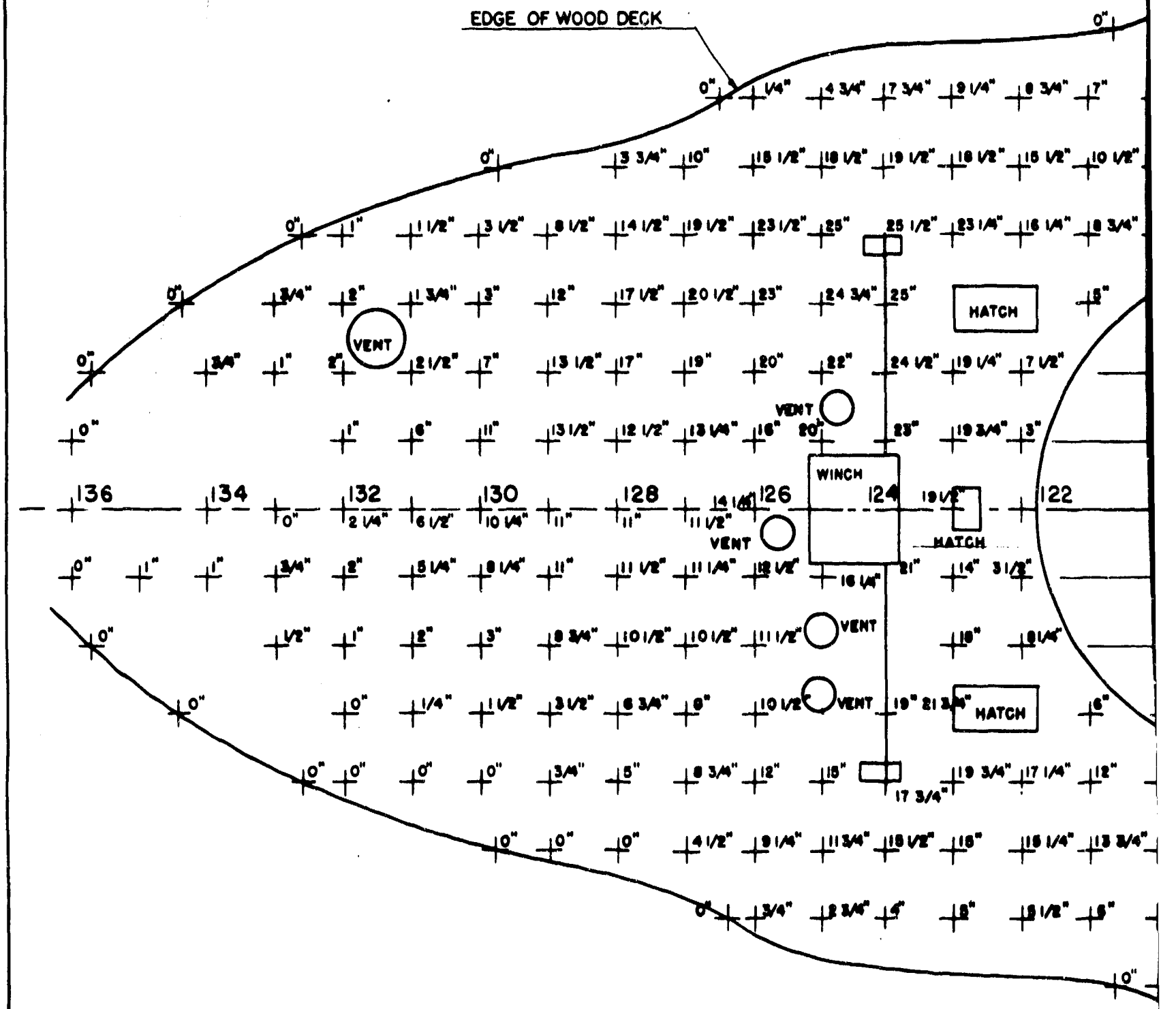
The camber curves indicated in all plots are faired lines and do not show local deformation which may exist between the five station points.

B. Measurements.

1. The procedure outlined in paragraph (A) was followed in the survey of the main deck of the USS ARKANSAS before and after Test A. The before test survey was conducted at Terminal Island Navy Yard on March 3rd, 1946, and the after test survey was conducted at Bikini Atoll on July 10, 1946. Superimposing the before and after survey plots indicated that the ships girder was unchanged.

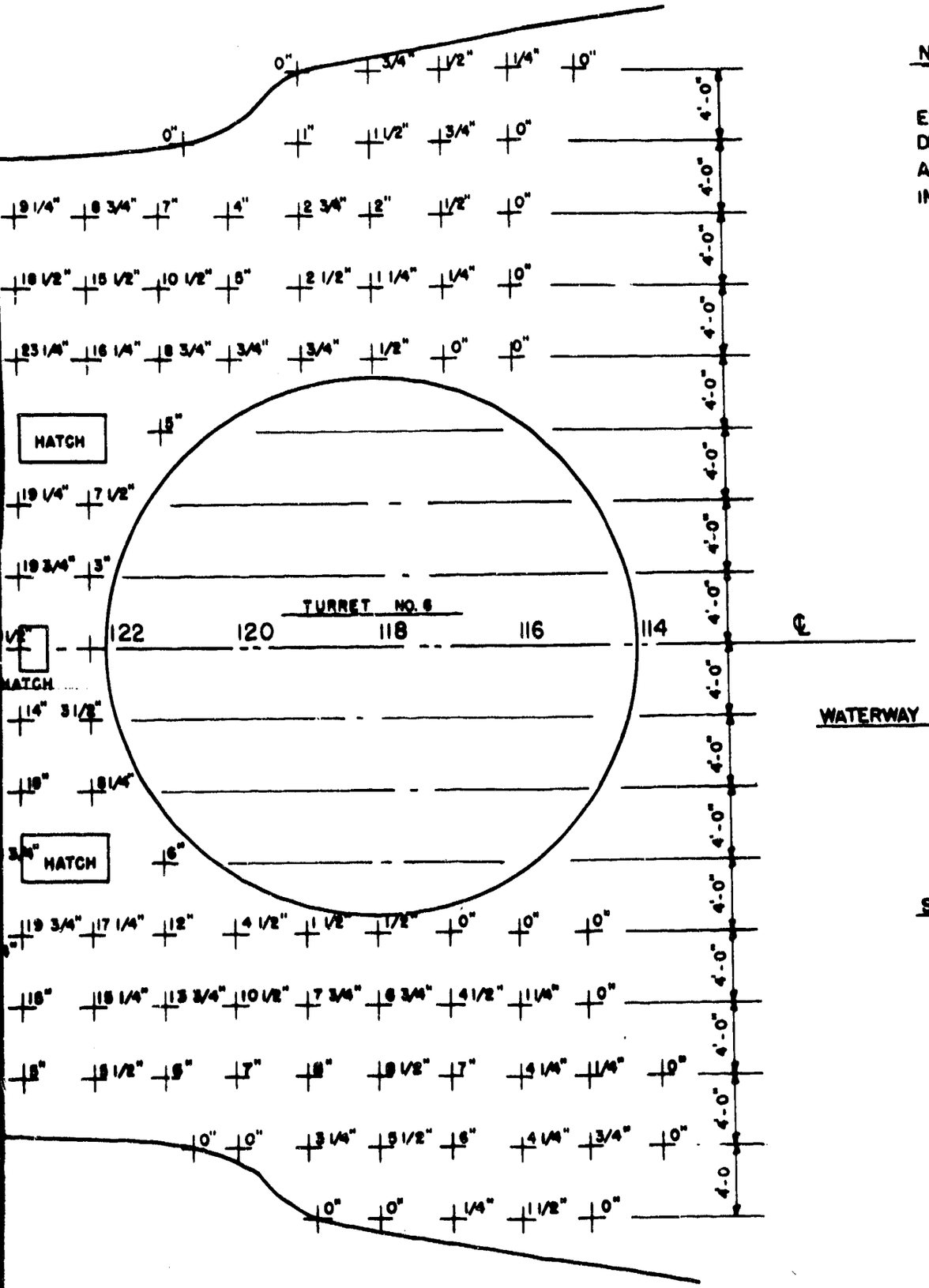
Serious local deflection in the main deck aft of turret number 6 resulted from the forces of the atom bomb burst. The amount and extent of this deflection were recorded and are shown on page ( ) . The maximum deflection in the main deck amounted to 25-1/2 inches.

2. Nine deck deflection gages were installed between the main and second deck as shown on page 84 . A maximum compression of 9-5/8 inches was recorded at frame 125. However, this is not the maximum compression of the main deck as the gage was compressed further and failed to record beyond 9-5/8 inches.



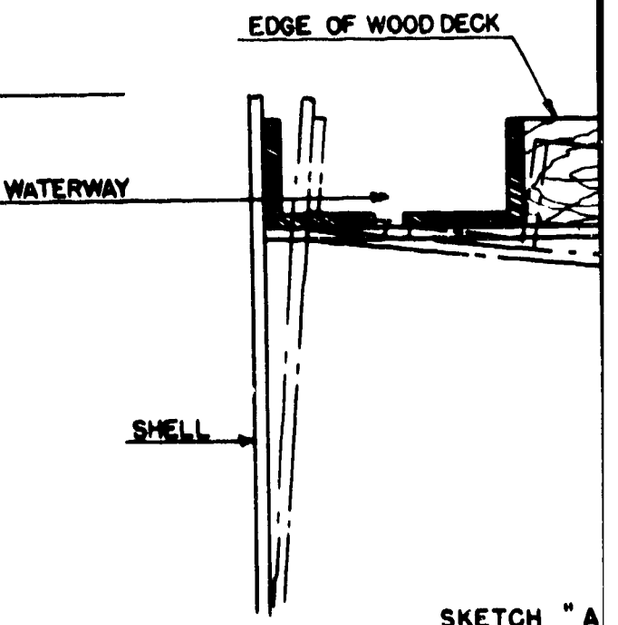
PLAN OF MAIN DECK

FRAME SPACING 4'-0"



NOTE :

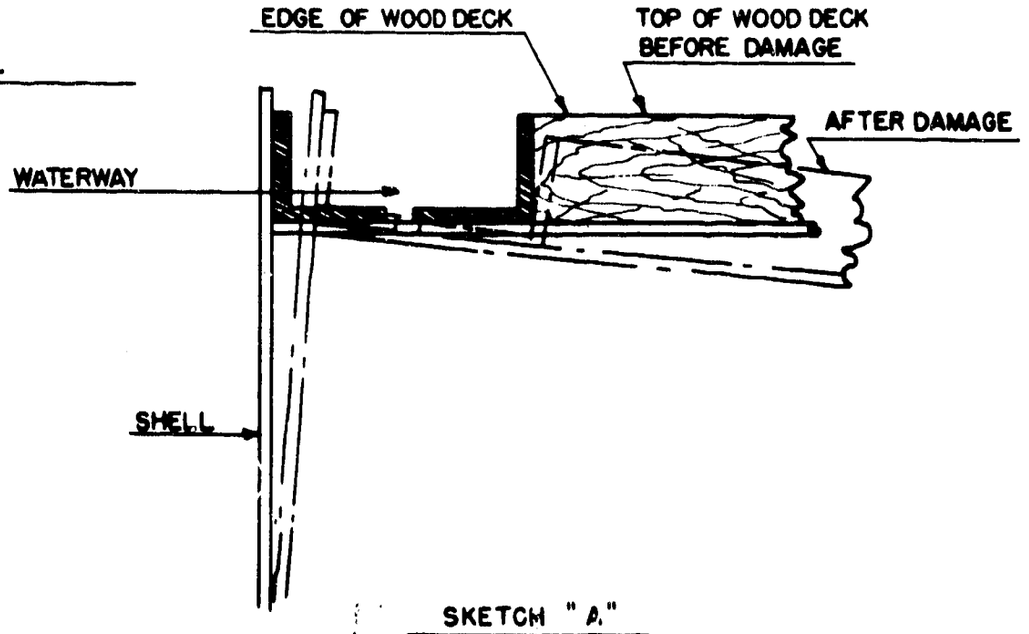
DEFLECTIONS WERE MEASURED FRO
ENDS OF THE STRING WERE EXTENDED
DEFLECTION. IN THIS RESPECT, IT WAS NE
ALONG THE SIDES WAS LEVEL WHICH IS
INBOARD AND DOWN. SEE SKETCH "A".



SKETCH "A

NOTE :

DEFLECTIONS WERE MEASURED FROM STRINGS STRETCHED LONGITUDINALLY ON THE DECK. ENDS OF THE STRING WERE EXTENDED TO PORTIONS OF THE DECK REASONABLY FREE OF ANY DEFLECTION. IN THIS RESPECT, IT WAS NECESSARY TO ASSUME THAT THE EDGE OF THE WOOD DECK ALONG THE SIDES WAS LEVEL WHICH IS UNTRUE. DISHING OF THE DECK CAUSED THIS EDGE TO PULL INBOARD AND DOWN. SEE SKETCH "A".



SKETCH "A."

3

SECRET

NAVY DEPT. BUREAU OF SHIPS

DECK DEFLECTION
TEST A

U.S.S. ARKANSAS BB 33

DECK DEFLECTION GAGES

SHIP USS ARKANSAS (BB-33) **TEST** A

LOCATION			MAXIMUM COMP.	MAXIMUM EXP.	PERMANENT SET		REMARKS
FR. NO.	DECK	DIST. OFF ℄			DISTANCE	EXP. / COMP.	
12	Main	Centerline	0-0-1/4	0-0-1/4	None	None	None
32	Main	Port	0-1-24	None	0-0-9/16	Comp.	None
32	Main	Centerline	0-0-5/8	None	None	None	None
32	Main	Stbd.	0-1-11/16	None	0-0-11/16	Comp.	None
100	Main	Port	0-0-1/4	0-0-3 16	None	None	None
100	Main	Stbd	0-0-1/8	0-0-1/16	None	None	None
113	Main	Port	0-2-5/8	0-0-3/16	0-1-3/8	Comp.	Tubler pipe bent inboard.
113	Main	Stbd.	None	0-0-5/8	None	None	None
125	Main	Centerline	0-9-5/8	0-0-5/16	0-9-5/8	Comp.	Gauge compressed beyond reading.

APPENDIX

COMMANDING OFFICERS REPORT

TEST ABLE

REPORT #11

COMMANDING OFFICERS REPORT

SECTION I

In the target array for Test Able the ARKANSAS (BB 33 - Wyoming Class) was moored to buoys fore and aft, with the port anchor under-foot. Open Bridge bearing 347° (T) distant 600 yards from the center of berth 161.

The ARKANSAS is the oldest battleship in commission, having been first commissioned 17 September 1912. She was modernized in 1926-27. Considering these facts, the ship was in a material condition comparably to her age. Watertight compartmentation was poor due to the lack of WT bulkheads, compartments and doors, plus the fact that areas designed for watertight integrity were in many cases found to be not watertight due to rusted spots, empty cable glands, poor ventilation duct closures etc.. Attempts were made in Terminal Island, California, to repair defects as far as possible, but the majority of watertight spaces still did not pass the air test.

Operating machinery was antiquated but functioned satisfactorily.

Topside and superstructure were in fair material condition, but rust and age were present. Bulkheads were thin and weak, unseen rivets were rusted, foundations of wood had rotted and foundations of steel had rusted. Protection for personnel was poor.

The many years of service of the ARKANSAS were inevitably reflected in the detailed damage caused by the Atom Bomb, as shown in Section II.

SECTION II

This section is divided into five parts and each part gives the detailed damage incurred under:

Hull
Gunnery
Machinery
Electrical
Electronics

SECTION III

PART C - INSPECTION REPORT

SECTION A - HULL

INDEX:

A. General Description of Hull Damage.

1. The overall condition of this vessel after Test A was very good. The major part of the damage received was on and above the main deck, though some damage was received below the main deck.

2. The general areas of hull damage were located in the superstructure, fore and main masts, the starboard side of the main deck aft of the aircastle, the stern, and on the second deck aft of frame 120. There was some buckling of bulkheads throughout the second and third decks.

3. The apparent cause of all the hull damage received was the blast effect of the explosion. The secondary effect of fires resulted merely in spot burning of the wooden deck on the boat deck due to Army Quartermaster gear, and paint work in the Boatswain's Locker.

4. The only flooding occurred in D-19-MS and in D-29 due to water backing up through the gravity deck drains. The shock of the blast affected the packing around the rudder post in the steering gear room, D-29, so that excessive leakage occurred. This compartment and D-19-MS have a common gravity drain to the starboard engine room bilges. The valve on this drain line in the starboard engine room was closed. The steering gear room flooded to a depth of about ten (10) inches and D-19-MS to a depth of about twenty-two (22) inches.

5. (a) The residual strength of the ship structure was somewhat impaired by the dishing of the main deck between frames 115 to 121 on the starboard side, and between frames 121 to 130 to a maximum of two (2) feet, extending the width of the ship. This dishing of the main deck caused the upper edge of the sheer strakes to be bent inward between frames 122 and 126, port and starboard, two (2) to three (3) inches from their original position. This bending of the sheer strakes extends downward about two (2) feet on each side from the upper edge. The dishing and rupture of the second deck aft of frame 123 was due to the force exerted by the dishing of the main deck through bulkheads, stanchions and ventilation ducts. The third deck is an armored deck that extends aft over the steering gear room and this deck was apparently undamaged.

(b) There was some loss of residual buoyancy. Though the effective freeboard remains the same to main deck level; ruptures above waterline of seams in C-135 and C-133; upper blister tanks, would allow these tanks to flood. The watertight integrity of the main deck has been lost aft of frame 121 and on the starboard side aft of frame 115 due to the dishing of the deck with the resulting shearing and loosening of rivets and the movement of the main deck away from the after part of barbette number six (6). Aft of frame 123, the watertight integrity of the second deck has been lost due to the dishing and resulting ruptures of this unarmored deck. The third deck maintained its watertight integrity.

(c) The operability of the hull itself seems to be generally unimpaired by the explosion.

6. The effective boundaries incident to progressive flooding are established as follows:

(a) The third (splinter) deck is watertight throughout.

(b) The second (armored) deck is watertight aft to frame 122.

(c) There would be slow flooding of Radio Two, C-112, through split bulkhead seams if the adjacent spaces were flooded.

(d) There would be flooding through the second deck in D-111, the Shipfitter's Shop.

(e) The athwartship boundaries on the second deck are the two (2) armored bulkheads at frames 40 and 77. These are not absolutely watertight but would allow only slow progressive flooding along the second deck.

B. Superstructure and Weather Deck.

1. The damage to the main deck was as follows:

(a) There was distortion of the main deck between frames 31 and 36, centering at frame 32, sixteen (16) feet from the centerline on both the port and starboard sides. The maximum depression in this area was two (2) inches with a final permanent distortion of three-quarters (3/4) of an inch. The wood decking was not torn loose.

(b) On the starboard side, outboard of the superstructure, between frames 61 and 68, the deck was dished in to a maximum of two (2) inches centering at frame 66-1/2 ten (10) feet inboard from the side. The entire area between the superstructure and the side of the ship was concaved.

(c) Another distortion of the main deck occurred between frames 68 and 75, extending from the barbette to the side and centering at frame 71, twelve (12) feet inboard with a maximum depression of one (1) inch.

(d) Between frames 80 and 88 the deck was depressed a maximum of three (3) inches centering just forward of hatch 1-83-1. This distortion extended from between barbettes number three (3) and four (4) outboard about twenty (20) feet. Both coamings of hatches 1-82-1 and 1-83-1 were affected by the dishing but these closures were still operable and watertight.

(e) Aft, the main deck was distorted between frames 115 and 121, starboard side, and aft of frame 121 extending the width of the ship to frame 135. The dishing was a maximum of two (2) feet at frame 124, with a one (1) foot depression at frame 121, starboard side of number six (6) barbette. Nine (9) stanchions were forced up through the deck at frame 129, port side. The dishing of the deck caused the upper edge of the sheer strakes to be bent inward between frames 122 and 126, port and starboard, two (2) to three (3) inches from their original position. The deck was pulled away about six (6) inches from the after side of barbette number six (6). Much of the wood decking on the stern was torn loose with some sections missing.

(f) The wood decking of the main deck was scorched generally aft of the aircastles and on the starboard side of the forecastle deck. Shielding affect was not too apparent aft, but on the forecastle it was plainly evident where the superstructure, army equipment and turrets had shielded the port side of the deck from the scorching of the blast and accompanying heat wave. Their sharp lines of demarkation were drawn between the scorched and untouched portions of the wood decking.

(g) 1. Though badly dished aft of frame 121, the main deck is still usable for all normal functions. There is no apparent weakness of the deck at the stern that would make it unsafe for personnel to conduct normal routine work in that area.

2. The starboard stern 20 MM shield at frame 135 was dished inward to an angle of 45 degrees. The welds at the lower edge of all the outboard stiffeners were torn apart. At each outboard corner the vertical plating had given at the weld and was rolled back from the horizontal stiffeners.

3. All the life lines had been blown away. The majority of the remaining life line stanchions were distorted while approximately 50 per cent of them were missing. The jack staff was bent to a 30 degree angle six (6) feet above the deck in a direction 290 degrees relative.

4. All towing fittings were undamaged though it is questionable if the main deck at the stern retains enough strength to make use of the towing pad. The ARKANSAS was moored with 45 fathoms of the starboard chain to the forward buoy and with 42 fathoms of one (1) and five-eights (5/8) inch wire to the stern buoy. In addition, 50 fathoms of ten (10) inch manila had been shackled to the stern buoy as a preventer. The manila had been scorched and weakened by the explosion and was cut by the initial salvage party. There were 40 fathoms of chain to the port anchor which was underfoot. There was no damage to any of the mooring fittings.

5. The boat boom, located at frame 42, starboard side, was badly scorched but was still usable. The rigging for the boat boom had been stowed below and was undamaged. Two (2) motor whaleboats were located on the port side of the boat deck. The inboard boat was missing while the outboard boat had been blown around ninety (90) degrees with its bow resting on top of the 20 MM gun shield. This boat was damaged beyond repair. The frames and planking at bow and stern were smashed and the boat throughout scorched. The majority of the life rafts were damaged by the blast. Those on number two (2) turret were blown down and demolished; as were those on the after two (2) turrets. The life rafts on the starboard side were all damaged beyond further use. Out of an original number of thirty-three (33) life rafts, five (5) were salvaged and retained aboard.

6. One plane had been secured to the top of number three (3) turret and was blown completely off the ship. At the time of the test the airplane handling gear consisted of the two (2) boat cranes. The starboard crane was rotated in a clockwise direction, bending the locking pin and riding up on it so that the crane was tilted inboard off its training rack about five (5) degrees. The end

of the starboard crane had ridden up over the port crane. There was no apparent distortion of the starboard crane king post and only a slight dishing of the outboard side of the platform shield on top. The coverings over the gears of both cranes were buckled and torn loose with those of the port crane in the worst condition. The top platform of the port crane was dished, ruptured and bowed upward on the inboard side with the outboard side of the platform undamaged. There was no apparent distortion of the king post and this crane was put in operation.

7. The forward winch was undamaged. The after winch at frame 124 received some damage. The deck in the way of this winch was dished to the maximum of two (2) feet. The motor foundation was cracked as was the inboard starboard bearing support. The starboard shaft was bent just outboard of the flange. The remote control reach rods were distorted and the control panel located on the bulkhead at frame 125, second deck, was knocked loose by the distortion of that bulkhead. This winch was put back in operation. The motor was dried out and the cable repaired as necessary. The reach rod controls were disconnected. The starboard shaft was broken at the flange and the cap of the bearing just inboard was loosened. The winch was tested and operated satisfactorily. Using the port shaft and nigger-head only it is estimated that a six (6) ton load could be handled with safety.

8. All fire hose exposed to the blast was found to be in good condition. Where exposed to the heat wave the surface of the hose was scorched but all hose was tested at a fire main pressure of around eighty (80) pounds pressure per square inch and found to be satisfactory. Fire plugs were scorched where exposed but were operable. All CO^2 extinguishers that were exposed to the blast retained their charge. In several cases the hose was badly charred and no good, though most of the hoses were still usable. In one case the extinguisher was knocked loose from its stowage and the valve handle was broken. However, the seal was unbroken and the extinguisher remained fully charged. Several twelve (12) foot applicators were distorted and unusable, but the majority of the applicators in the topside exposed stowages were undamaged.

9. The damage sustained by the main mast and after superstructure:

(a) The starboard leg of the main mast was torn free from both the main and second decks. The rivets were sheared at both flanges. The mast was tilted toward the port bow, raising the free starboard leg about nine (9) inches and creasing the center and port legs on the forward port sides about five (5) feet above the main deck. The main top mast was torn loose and was found with the top of the mast resting on the main deck at frame 94, six (6) feet to port of the center line, and the base of the mast with the yard arms attached but distorted, jammed in between the 03 and 04 levels.

(b) The 20 MM clipping room side and after bulkheads were dished in, the after one being washed-boarded, and the starboard bulkhead was torn loose from the deck and stiffener at the weld for a distance of two (2) feet. The starboard side of the overhead was bulged upward, and at the after upper edge was torn apart at the welded seams the entire length of the shack and bent upward about one (1) foot at the starboard after corner. This was due to the upward and forward movement of the starboard mast leg. The overhead to port was dished about four (4) inches. The starboard door had been buckled and the upper hinge snapped at the weld. The port door had buckled with the bulkhead but was still operable.

(c) The high engine room ventilation intakes, at frame 99 port and starboard, forward and inboard casings were dished. Welds on both the inboard plating failed. The after vertical seam failed the full length where welded to the clip shack forward bulkhead, about four (4) feet. There was a nine (9) inch split in the forward inboard corner seam in way of the corner of the horizontal supply casing. The inboard starboard plate and weld failed at the same point as well as a short welded seam failure at the upper edge of the clip shack bulkhead. The Officer of the Deck's booth was dished and the door buckled.

(d) On the 01 level, Radar Aft, the forward bulkhead was dished in way of the center door a maximum of four (4) inches. The door was warped but usable. The after bulkhead was dished about six

(6) inches. The radio antenna lead in ducts were dished and distorted. The supports were warped or torn loose, but none of these ducts were torn off completely.

(e) On the upper levels of the main mast there was considerable dishing and warping, with some rupturing of welded seams on the 04 level. The starboard and after shields of these levels received the major part of the damage with the worst dishing on the 04 level. The thirty-six (36) inch searchlight was blown from the starboard side of the 04 level to the main deck at frame 70 just inboard of the port side.

(f) The initial blast and pressure appears to have caused the damage sustained by the main mast. Except for the scorching of the paint by the heat wave there was no evidence of fire in this structure.

10. Aft of the aircastles the superstructure was considerably distorted. The port side was dished in about nine (9) inches in way of the galley and gunnery office. The doors were warped and distorted but were usable except for door 1-64-2 which had to be removed to affect an entrance into the gunnery office. The starboard side was dished in between frames 62 and 70-1/2. All the doors were badly distorted and door 1-64-1 was blown into the potato peeling room. In way of the doors on the starboard side the plating was split and ruptured. Rivets had sheared or pulled out. The maximum dishing of this bulkhead was about fifteen (15) inches. The forward bulkhead of the potato peeling room was blown into the bake shop with the upper edge torn loose, the rivets shearing. The corner just inside and aft of the door was blown out with the rivets shearing. The after bulkhead of the galley was convexed, pushing the steam kettles forward putting several of them out of commission.

11. The after bulkhead of the boatswain's locker, between frames 71 and 73, starboard after part of the superstructure, was dished in about six (6) inches and the door was distorted. Hatch 01-71-1 was blown off and was found twenty (20) feet away on the boat deck. A fire started in this space and all equipment was burned. There was no evidence of the fire spreading beyond this space.

12. In the starboard aircastle one shutter in each of the five (5) inch gun ports was blown closed while the others were warped and bent over the rail support. The starboard gear locker aft of the aircastle, frame 62, was dished in on all sides and broken loose from a third of its braces. The doors were distorted beyond use. The door to repair locker I-B was blown into the locker. The inboard bulkhead of the starboard aircastle between frame 42 and 62 was dished in various places. The bulkheads in the athwartship passage between the aircastles were bulged outward several inches. Door 1-51-1 was blown off into the port aircastle and the surrounding bulkhead dished and to rn loose from the deck. The after door into the port aircastle was demolished and the bulkhead was bent in and torn loose from the deck. The joiner door into the officer's galley was blown in and distorted beyond further use. The shutters for the port five (5) inch gun ports were blown closed by the blast of the vacuum effect.

13. The superstructure deck, or boat deck, 01 level, between frames 39 and 73, received the following damage:

(a) The hand rails on the starboard ladder leading from the main deck to the boat deck at frame 62 were bent and distorted. The platform for this ladder at the 01 level was blown over to the port side.

(b) The stack was lying to port, in the space between the port crane and the foremast, supported on the outboard side by the MARK 51 director. The stack had been crushed and warped, shearing the rivets at the flange of the uptakes just below the 01 level, and shearing the plating and rivets of the outer casing. It appears that the stack was first crushed by the pressure rather than knocked over by the blast. The starboard stays parted and after being crushed the stack fell forward of the port crane. The whistle was torn off and thrown to the port side of the navigation bridge.

(c) The structure between frames 65 and 68, amidships, which contained a crew's head and the battery locker was crushed and distorted on the after side with some dishing of all

bulkheads. The crew's wash room was demolished by the shock. The outboard drain and salt water flushing line for this head were ruptured. The hand rails on the top of this structure were broken loose from the base and bent out of shape.

(d) The wood decking burned at the following locations:

(1) Port side from frame 49 to 55, an area twelve (12) feet by thirty (30) feet.

(2) Starboard side from frame 54 to 55, an area six (6) feet by ten (10) feet, and from frame 57 to 59 an area of three (3) feet by eight (8) feet.

This decking was burned through to the metal deck. These fires were due to the Army Quartermaster gear that was secured in these locations. Only those items which were exposed and which were packed and wrapped with burlap caught fire.

(e) The metal deck aft of frame 60 was distorted and dished to a maximum of about six (6) inches. At frame 61, port side, a welded seam was pulled apart about one (1) inch a distance of two (2) feet. The gear locker located at frame 59-1/2 was broken loose from its foundation and thrown on its side one (1) foot away. The intake vents for the fire rooms were dished and the expanded metal screens blown out.

14. The deck of the 02 level was warped slightly and the starboard shields were dished at various places to a maximum of about one-half (1/2) inch. The after port and starboard 20 MM ammunition lockers, frame 52, were distorted, torn loose and damaged beyond further use. The ladders leading from this level to both the 03 and 01 levels are warped and sprung on the port side. The after side of the ammunition ready service stowage at frame 50, inboard starboard side, is dished in about four (4) inches and torn loose along the upper edge.

15. On the 03 level of the foremast, the signal bridge, both the port and starboard flag bags were demolished completely. The shields were dished along the after and starboard sides with maximum distortion of four (4) inches along the upper edge of the after starboard shield. Three (3) twelve (12) inch searchlights were blown from their mountings and two (2) were smashed beyond repair. The deck is warped and dished to a slight degree. The bulkhead and doors of bridge radio, frame 53, were dished though the doors remain operable and can be dogged. The starboard after corner is bent in upon itself about nine (9) or ten (10) inches. The after bulkhead was dished in about one (1) foot. The chart house bulkhead at frame 48 port was dished in one-half (1/2) inch. The glass in the two (2) starboard ports in the pilot house were shattered by the blast. The starboard halyard stanchion was broken off at the deck. An expanded metal life jacket stowage on the overhead by the mast leg was demolished completely.

16. On the 04 level, the open bridge, the twenty-four (24) inch searchlight stand was snapped by the shock of the blast. The bulkheads and shields were dished moderately, with a maximum depression of three (3) inches on the starboard side. The deck was dished and warped. No ship control equipment was damaged on the open bridge.

(a) The major damage to the foremast occurred at this level. Both of the after legs of the tripod were cracked and split vertically in way of the contilever supports of the altimeter platform. Along the welds on the inboard sides of these supports, the mast legs were pulled apart the vertical length of these supports and along the bottom weld. The port support was pulled out and upward about one-half (1/2) inch while the separation of the starboard vertical split was a maximum of some three (3) inches at the base of the crack. The outboard, starboard, secondary support welded to the mast leg pulled loose at the bottom horizontal weld. The vertical weld held and caused the mast leg to crack horizontally a length of about two (2) feet, along the outboard side of the mast leg, with a maximum separation of about one eighth (1/8) inch.

17. On the 05 level, air defense forward, the altimeter platform was bent upward from the tripod to the after starboard edge at an angle of about five (5) degrees. The after shield was bent forward about fifteen (15) degrees from normal causing the deck to split about three (3) inches at the starboard side of the shield. The range finder housings were demolished. The range finder equipment amidships was moved forward four (4) inches. The platform was torn loose from its outboard starboard brace. The port side hand rails were demolished, as was the after starboard section. The starboard shield was dished in about eight (8) inches at frame 50 and the port shield was bulged outward. There were several small weld failures due to the dishing of the starboard shield. The switch box bulkhead, attached to the forward side of the center leg was blown down and distorted, with several selector switches destroyed. The doors to the MARK 50 director were dished in.

18. On the 06 level, the standard compass binnacle was blasted from its base. The bolts holding the binnacle were still in place in the deck with pieces of the wooden foundation. The port hand rail was broken apart and bent outward.

19. On and above the 07 level, the damage received was:

(a) The after bulkhead of the secondary battery control forward was dished in to a maximum of six (6) inches on the starboard side. Both range finders were badly damaged.

(b) All the superstructure above the 07 level was dished, warped and out of line. The fore-top mast was bent in a direction 290 degrees relative and below the horizontal. All the radar antenna were demolished. The overhead of Spot One was pushed forward and down toward the port bow.

C. Exterior Hull Above Water Line.

1. The hull plating itself withstood the effects of the blast and generally remained in good condition.

2. The distortion of the main deck aft of number six (6) barbette caused the upper edge of the sheer strakes to be bent inward between frames 122 and 126, port and starboard, two (2) to three (3) inches from their original position. This distortion extended downward about two (2) feet on each side from the upper edge.

3. The hull plating was dished in to a maximum of about nine (9) inches, at frame 136-1/2, between frames 135 and 137-1/2 starboard, from about one (1) foot below the upper edge of the sheer strake down nine (9) feet.

4. Plating welded in the old secondary battery gun ports on the second deck were affected by the blast. The plating of the stern gun port was dished in to a maximum of about four (4) inches but remained intact with no sign of weld failure. The weld of the plating between frames 64-1/2 and 66-1/2, starboard, cracked along the upper edge of the plating, in the gun port. At frame 120 the lower weld cracked, starting at the sharp outboard corner and running inboard about eighteen (18) inches. At frame 128 the lower weld at the corner had started to give as well as the entire lower weld from the corner inboard.

5. The lower edge of an overboard discharge at frame 115, starboard side, two (2) feet below the top of the lower blister, was split open. This was due to the dishing of the blister, D-115, by the shock of the blast. This split opened the blister to sea as well as to the drain discharge. All the blisters on the starboard side aft of frame 65 and above the waterline, were dished in by the blast. The tank bulkheads held, but the frame stiffeners were bent and distorted. The spot welds to the armor plating had failed. Ruptures of seams in C-133 and C-135, upper blister tanks, would allow these tanks to flood slowly from sea.

6. The side armor belt is hung inside the blisters and was not damaged in any way by the blast.

D. Interior Compartments, Second and Third Decks.

1. (a) Between frames 31 and 36, port and starboard, outboard of number two (2) barbette, the fore and aft joiner bulkheads forming wardroom staterooms were slightly buckled along the upper edge. This was due to the distortion of the main deck to a maximum of two (2) inches by the blast.

(b) In the after starboard crew's berthing space numbers five (5) and seven (7), overhead frames 63 to 67 and 71 to 73 were convexed about one (1) inch. The upper weld of the plate in the old gun port between frames 64-1/2 and 66-1/2 was cracked and pulled apart. Just inboard, the joiner and expanded metal forming the boundaries of a gear locker were distorted and twisted from the concussion and distortion of the main deck.

(c) The bulkheads surrounding the uptakes on the second deck were bulged outward a maximum of one (1) to two (2) inches by the force of the blast downward when the stack had been torn loose. The doors into the uptakes were also bulged but still usable. The uptakes were pushed downward somewhat but not ruptured. With the exception of lockers that were torn loose from the bulkheads and thrown over, all equipment in this space was still operable.

(d) The after bulkhead of the Log Room at frame 103 port side, was buckled and torn loose from the overhead. Rivets were pulled out from the bulkhead stiffeners. The stanchions in this space were slightly bowed. The damage was caused by the distortion of the main deck.

(e) The inboard bulkhead frames 104 to 110, starboard, forming the sick bay room, were concaved from the overhead to second deck. Bulkhead stiffeners were buckled but were still intact. The after joiner bulkhead of the operating room, frame 103, was slightly dished and distorted but was intact. The inboard bulkhead of the sick bay office was concaved and bulged. All this damage was caused by the depression of the main deck.

(f) The joiner bulkheads between frames 78 and 96, starboard side, forming office spaces, were only slightly buckled and stiffeners bowed due to distortion of the main deck. In the executive officer's office, between frames 78 and 82, the inboard joiner bulkhead was warped and distorted du e to concussion of the blast coming from the supply vent about six (6) feet inboard of this bulkhead. It appears that some loose gear could have been blown against the joiner bulkhead. There was depression of the main deck in this area.

(g) In the sick bay treatment room between frames 96 and 98, starboard side, the joiner bulkhead was fractured at the overhead joint with rivets and tack welds pulled loose. At frame 99, port side, the athwartship bulkhead was buckled at the overhead and joiner bulkhead rivets were pulled loose from the stiffeners. Inboard, the expanded metal siding and joiner work of the ice cream bar were ruptured, in the area of frame 95. Three (3) channel beams were concaved but stanchions were still intact. Distortion and dishing of the main deck caused this damage.

(h) In the barber shop, located between frames 95 and 101, inboard port passageway, the inboard joiner bulkhead stiffeners were fractured and bulged at the overhead joints. Stiffeners were somewhat twisted at frames 99 and 100. The casings of the engine room supply duct are wash-boarded from the blast entering these ducts.

(i) In the area of sick bay, frames 105 and 115, starboard side second deck, there was some damage due to the slight dishing of the main deck. The inboard bulkhead and after joiner bulkhead were slightly bulged near the overhead but remained intact. Some bunk stanchions were bent but not excessively.

(j) In the crew's berthing area, frames 115 to 129, starboard side of the second deck, all damage sustained was due to the blast dishing and buckling the main deck to a maximum of two (2) feet. Stanchions were bent and broken loose from the deck or twisted. One stanchion pushed through the main deck a distance of four (4) inches. All frames in the overhead are convex, broken or

spread apart at riveted joints but remain attached to the side frames. The lowest point of the overhead is five (5) foot four (4) inches. The unarmored portion of the second deck, aft of frame 122 is dished to various depths, to a maximum of approximately sixteen (16) inches at the athwartship bulkhead of the crew's wash room, frame 125. The decking split in front of the entrance to the crew's wash room and is dished and broken at the point where a ventilation duct went through the deck, frame 122 about fifteen (15) feet to starboard of the center line. The ruptures in the deck were possibly due to the rusty condition of the deck which had reduced it to about half its original strength. The overhead was pulled away from the after edge of number six (6) barbette to a maximum of about six (6) inches, due to the dishing of the main deck.

(k) In the crew's wash room, frames 125 to 138, starboard and center line of the second deck, the bulkheads and stanchions were buckled due to the dishing of the main deck. There was some dishing of the second deck by the pressure of the stanchions before they buckled or broke off at the deck. Riveted seams were split and the forward bulkhead was twisted and buckled. The plating welded in the stern gun port was dished in to a maximum of about four (4) inches but remained intact with no sign of weld failure. The overhead frames were dished and twisted, extending from nearly normal outboard to maximum distortion at center line. The starboard shell plating was dished in between frames 135 and 137-1/2 to a maximum of about nine (9) inches at frame 136-1/2. The center line bulkhead between frames 125 and 134, split at the riveted seams and buckled to starboard to a maximum of eighteen (18) inches at the extreme point of buckling. The deck was dished downward and slopes from frame 132 to 125 which is the low point of the dishing of the second deck.

(l) In the crew's head, frames 125 to 134, port side second deck, the damage was caused by the failure of the main deck and its resulting dishing. The deck is dished in the areas around the stanchions to a maximum of five (5) inches, and all stanchions are slightly bowed. The deck has a general slope from frame 131 forward to frame 125, the deepest point of dishing occurring at the athwartship bulkhead and is approximately thirteen (13) inches. The port

bulkhead between frames 125 and 129 is twisted so that it has a washboard effect. It is split at the riveted seams at several points. The maximum bulge of this bulkhead is about seven (7) inches. The overhead height at the lowest point is six (6) feet four (4) inches. The one joiner bulkhead is bulged three (3) inches.

(m) The cause of the damage in the crew's berthing space, port side second deck, between frames 115 to 129, was the dishing of the main deck. The stanchions were buckled but remained fastened to both the deck and overhead. The framing was buckled and twisted but to a lesser degree than the starboard side. The lowest point of overhead height was five (5) feet seven (7) inches. The deck was dished, extending from the skin of the ship inboard to a maximum of about ten (10) inches.

(n) The overhead of both the post office and tailor shop, located at frames 113 to 115, starboard and port respectively, was slightly dished downward. The forward joiner bulkheads of both spaces, at frame 113, were somewhat bulged near the overhead.

(o) In the laundry, located between frames 105 and 115, port side of the second deck, the overhead gave a maximum of about one (1) inch. The inboard fore and aft joiner bulkhead was bulged and the riveted angle iron at the deck was torn loose. The after bulkhead was buckled and the transverse stiffeners were broken loose from the main deck.

(p) The port and starboard passageways between frames 105 and 115, second deck, were undamaged, except for the dishing of the overhead. In the port passageway the gauge indicated that the concussion of the blast depressed the main deck a maximum of three (3) inches, with a permanent dish of one and one half (1-1/2) inches.

(q) On the third deck, located between frames 122 and 138, the damage sustained was due to the failure and dishing of the second deck. At frame 126, the low point of overhead height was reduced to six (6) feet six (6) inches. The stanchions were bowed and broken loose from the overhead frames. Frames 125, 126 and 127

received the worst damage and were dished and twisted considerably. This was due to the bulkhead on the second deck transmitting the shock of the blast through to the second deck framing. The overhead was dished from frame 132 forward to the low point at frame 126. The one joiner bulkhead was bulged but remains intact.

(r) In Radio Transmitter Room, located amidships between frames 92 and 102, third deck, the forward part of the bulkheads were distorted and buckled by the shock of the blast transmitted through the forward leg of the main mast and by pressure coming through the supply duct from the point this duct was ruptured in number one uptakes. The starboard bulkhead was bulged outward between frames 95-1/2 and 98, and the port between frames 92 and 98. The forward bulkhead buckled forward a maximum of three (3) inches. Doors 3-96-1 and 3-96-2 were buckled along with the bulkhead but were capable of being closed and dogged. Door 3-92-2 was badly sprung but could be forced closed. The forward starboard outboard corner about one (1) foot above the deck had opened at the seam of the plates forming the bulkheads. This was a riveted seam and the rivets had pulled loose. There was a slight dishing of the armored deck around the base of the center main mast leg. The weld between the mast leg and overhead on the forward starboard side was cracked. There was approximately a five (5) per cent reduction of watertight integrity of this space. Its habitability and utility were unimpaired and the equipment was operable.

(s) On both the second and third decks the bulkheads surrounding the uptakes are bulged outward but remain intact. The forward bulkhead of number one intake, frame 58, third deck, is concaved forward. This was due to the force of the blast entering both the uptakes and intakes.

(t) In the Provision Issue Room, located forward of number five (5) barbette to starboard of amidships, there was damage caused by the movement of the starboard main mast leg. This mast leg was riveted to the second deck at frame 103, fifteen (15) feet outboard of the center line. The mast leg was pulled away from the deck, shearing all the stud rivets of the lower flange and being permanently raised nine (9) inches. There was no rupture of the second deck. The overhead frame 103 was distorted by the mast leg being forced up against it.

The main deck flange was torn loose leaving a two (2) inch wide circular opening through the main deck into the Issue Room around the leg of the mast.

2. Door 3-58 was distorted to such an extent that it could not be closed and properly dogged. The doors leading into the uptakes on both the second and third decks were distorted along with the bulkheads but were not jammed or inoperable.

3. The condition of the equipment on the second and third decks was satisfactory. In the crew's head, port side between frames 125 and 134, there was breakage of the main supply line of flushing water and smaller pipes to the heads themselves near amidships. This main supply line was supported from the overhead. The concussion on and distortion of the main deck caused the piping failures. None of the drains which ran under the second deck were ruptured on the port side. However, the drains from the crew's wash rooms, starboard side between frames 125 and 138 all failed. These drains all had long runs and the shock of the blast caused the failures. There were some cable failures on the second deck at frame 125 due to the buckling and distortion of the bulkheads. There was no evidence of fire on the second or third decks.

4. The watertight integrity of the main deck has been lost aft of frame 121 and on the starboard side aft to frame 115. The dishing of the deck in this area pulled it away from the after part of number six (6) barbette. Aft of frame 123, the watertight integrity of the second deck has been lost due to the dishing and resulting ruptures of the unarmored deck. An estimate of the reduction of watertight integrity of the second and third decks would be about fifteen (15) per cent. The habitability of the second deck aft of frame 115 is about zero due to the concaved overhead and loss of watertightness of the main deck. The outboard water closets of the crew's head aft were put back in operation by running a jumper for flushing water but the washroom to starboard is not usable. The shipfitter's shop, D-111, can be used as a work shop but no longer as a berthing space due to the loss of ventilation and the dampness of the space due to leakage through the main and second decks. All other compartments on these two (2) decks are habitable and can be utilized for their designed purposes.

E. Interior Compartments, Below the Third Deck.

1. The fore and aft bulkhead that separates the port and starboard engine rooms is buckled slightly. The buckling evidently commenced at frame 97, beneath the lower end of the center leg of the main mast and worked fore and aft. The third deck around the base of the main mast leg is slightly dished. The buckling of the engine room bulkhead was due to the shock of the blast transmitted through the third deck by the main mast leg.

2. Below the third deck there was no damage sustained by the ship other than several pipe connections to condensers failing due to the shock and whip of the ship. There was no reduction in the watertight integrity, habitability or utility of compartments on or below the first platform deck.

F. Underwater Hull.

1. The interior inspection of the underwater hull indicated that no damage was received.

2. The damage resulted in no present loss of buoyancy. With the loss of watertight integrity of the main and second decks aft of frame 121, some residual buoyancy has been lost. The damage did not affect the operability or maneuverability of the ship.

3. There is no known damage to the shafts, propellers, struts, rudder or external keels.

4. In so far as can be determined, there is no impairment of the keel structure.

G. Flooding.

1. There was no flooding resulting from the direct effect of the explosion. The major flooding that occurred was in the steering gear room, D-29, and a starboard magazine, D-19-MS.

2. The source of this flooding was through the gravity deck drains in D-19-MS and director leakage through the stuffing box of the rudder post in D-29. The flooding of the magazine occurred because both compartments have a common gravity drain to the bilge of the starboard engine room, and there are no closures for the deck drains in D-19-MS. The one valve on this gravity drain is located in the starboard engine room and this valve was closed. This resulted in the water flooding D-29 to a depth of about ten (10) inches and backing up into D-19-MS to a depth of about twenty-two (22) inches. There was no evidence of any damaged piping or opened boundaries.

3. No other compartments flooded except the two (2) mentioned in the above paragraph. If the ship had been manned and operating this flooding would not have occurred as the drain valve would have been opened. Even if the valve were inadvertently closed this flooding would have been discovered and corrective measures taken.

H. Ventilation-

1. (a) The vent duct located at frame 80, in compartment C-106, was demolished between the second and third decks. Branch ducts as well as the main duct were split open. The cause of this damage was due to the blast entering the topside mushroom vent. Ventilation closures 1-80-1 and 2-78-1 were still operative. The loss of use of this system would have only a slight adverse effect on habitability but would cause magazine temperatures in some of the Group C magazines if not repaired and put back in operation.

(b) In the crew's head and living spaces, frames 115 to 132, all vent ducts were damaged due to the caving-in and buckling of the main deck with the resulting buckling of second deck bulkheads frame 125 and aft. The ducts were supported on the overhead or loading down through the second deck. These ducts were all buckled and broken apart at the joints. All closures appear to have held as there is no evidence of heat or blast having been conducted through

the ventilation system from topside. The habitability of this space was destroyed due to the buckling of the main deck. The loss of ventilation would have only a slight effect on the habitability due to the proximity of hatches leading to the main deck.

(c) In the Shipfitter's Shop, compartment D-111, third deck, frames 122 to 132, damage done to the ventilation system was due to the buckling of the second deck and not to blast being conducted by the system. The ducts are supported from the overhead and the buckling of the second deck caused the system to give and part at the joints. Unless repaired or temporary ventilation set up the habitability of this compartment would be lost. Closures were rendered inoperable due to the buckling of the deck and vents and the resultant throwing out of alignment of these closures.

(d) In the crew's berthing space, compartment D-109, frames 105 to 115, third deck, damage was done to the supply ventilation system 3-113-1. This was caused by the topside vent closure being inadvertently left open, which allowed the concussion of the blast to enter the duct, tearing loose the section of vent duct at the turn where it enters the blower 3-113-1. This section of duct was destroyed from the overhead to the blower casing. The habitability of this and other spaces supplied would be somewhat impaired until this system was repaired.

(e) The topside closure was inadvertently left open on the emergency diesel exhaust. This resulted in the blast bulging this line on the half deck at frame 31, just aft of the Warrant Officers' Pantry, port side. The bulging occurred in a straight section of the exhaust duct, bulging the line a length of about two (2) feet. The insulation remained intact. There was no adverse effect as the result of this casualty on either closures or habitability.

(f) At frame 58, center line, in number one (1) uptakes, the vent duct was broken at the joint just aft of blower set 3-58-2. This was evidently caused by the shock of the blast. It was a sheet metal duct and gave at a crimped joint. The effect on habitability is negligible, there being only a small loss of air going to Radio Two.

2. In no case were the ventilation closures broken by the blast. Where there was evidence of the blast being conducted along the ventilation system it was due to personnel failure to secure the topside vent closures. The biggest part of the damage sustained by the ventilation system was due to the buckling of decks with the resultant buckling of the ducts themselves.

3. There was no progressive flooding as the result of ruptured vent ducts or closures. The ruptured ventilation duct in C-106 would have allowed progressive flooding into lower spaces supplied by this system, unless the lower sections were watertight and all closures properly secured. Aft of frame 115 the ventilation system would have allowed progressive flooding into D-27, steering aft.

4. The defects of the ventilation system of the ARKANSAS are that the ducts are too lightly constructed and not well enough supported, and there are not sufficient closures at watertight boundaries. Aft of frame 115 on the second deck and in compartment D-111, all damage to the ventilation system was the result of the buckling of the main and second deck with the resulting breaking of the ducts. In the cases where ruptures were found in the vent ducts on the third deck, closures at the second deck level would have prevented the concussion of the blast penetrating as far as it did, as well as removing the possibility of progressive flooding in third deck spaces through the ventilation system.

I. Ship Control.

1. There was no major damage inflicted on ship control equipment. The following minor damage is noted:

(a) Two (2) glass ports on navigation bridge cracked; no pieces broken out.

(b) Isinglass windshields on open bridge blown completely away.

(c) TBS is bridge radio pushed on to deck by dished-in bulkhead; suffered severe damage from the fall.

(d) One MARK 8 Model 3A gyro compass had a small amount of mercury spilled from the bowl. This did not affect the operation of the compass.

(e) The magnetic compass binnacle located aft on the third platform above the navigation bridge was broken from its foundation and blown on to the next lower platform.

2. So little damage occurred to ship control equipment that criticism on layout and protection for effects of the atom bomb at the distance which the explosion occurred would be difficult. The only important effect would have been the killing or seriously injury of most of the personnel stationed on the foremast.

J. Strength.

1. There was no evidence of any permanent hog or sag. All the major hull damage was received aft of frame 115, starboard side to aft of number six (6) barbette where the dishing of the main deck extended the width of the ship. No apparent evidence of longitudinal stresses was noted.

2. The only failures in way of structural discontinuities occurred aft of frame 121 on the second deck. There stanchions riveted to overhead framing had sheared and been twisted by the distortion of the main deck frames. The plating of the main deck was displaced, opening the seams behind in way of the framing and butt straps. Few rivets were sheared but all between frames 121 and 134 were loosened and displaced. Welds on the plating closing the old secondary battery gun ports cracked in several places on the starboard side, namely: Between frame 64-1/2 and 66-1/2 along the upper weld, at frame 120 the lower weld cracked at the sharp corner and inboard about eighteen (18) inches, at frame 128 the lower weld at the corner had started to give as well as the entire lower weld from the corner inboard. These welds may have

given under the initial pressure and shock of the blast or they may have cracked due to the stresses set up by the dishing of the main deck.

3. Panel deflection under blast was evident in most plating under fifteen (15) pounds gauge. Where shielded, the deflection was noticeably less but direct exposure to the blast the deflection was a maximum. Structures and shields in both the fore and mainmasts were distorted. The bulkheads of the superstructure in way of the galley and spaces just forward appear to have been crushed by the exertion of pressure rather than by the initial shock of the blast as both sides of this after part of the superstructure were dished and buckled equally.

4. Foundations were undamaged by this explosion with a few exceptions. The after winch motor foundation and inboard starboard bearing mount were cracked as a result of the dishing of the main deck. In way of this winch was the maximum depression of the deck, about two (2) feet. The right trunion block of the right gun of turret number four (4) was cracked, evidently due to the gun receiving the force of the blast against the length of barrel.

K. Miscellaneous.

1. Since this vessel had but one color of camouflage paint there was no evidence available of heat damage variations. However, there were cases of variation of heat damage within close radius to the paint work which indicated that the heat wave did not travel as a solid front but rather was broken into segments. One instance was the starboard 3 inch/50 gun located adjacent to the quarter deck. The paint on the barrel showed evidence of having been subjected to extreme heat that increased the maximum charring of the paint work around the breech. The bulkhead just inboard of this gun showed less heat effect than the gun itself and yet both were equally exposed to the blast and heat wave.

2. All paint work that was exposed to the heat wave and blast charred in varying degrees but only the top layer was affected. Paint below this outside coat appears to have remained in an undamaged condition.

3. It is interesting to note that the grass and moss was cleaned off the side of the ship for approximately three (3) feet below the water line aft of the aircastles on both port and starboard sides.

SECTION III

PART C - INSPECTION REPORT

SECTION B - GUNNERY

INDEX

A. Turrets, Guns and Mounts.

(a) Protected Mounts.

Damage to the outside of the turrets was superficial. It consisted of, first; burned and chipped paint on those positions of the barbettes and turrets exposed to the blast and heat wave. On the sheltered side the paint was normal, indicating that most of the damage to paint was due to the blast effect, and that the heat wave was of short duration. Second; the bloomers were torn and shredded on the four after turrets, by the blast. The range-finders on turrets 2 and 5 were carried away by the blast.

Conditions inside the turrets were normal, except turrets 4 and 6. The greatest damage sustained was in turret 4, where the outboard trunion block of the right gun was cracked both fore and aft by the shock wave along the length of the barrel. The turret was trained 075° (R) placing the point of indicated detonation of the bomb almost normal to the gun barrel. The inboard block was not damaged. This gun is not in condition to be fired, however, it can be elevated without difficulty. The after part of the block is in place although it has a crack originating at the cap square and running up and aft. The forward part is broken clean with the cap square as the origin of the break. This constitutes a major damage. Turret 6 suffered no damage that would put it out of action. A section of vent line was broken off in the blower room. The trainer's hatch was open directly above this room, however, it appears that shock broke the vent line in that no other damage is apparent. The optics were burned in varying degrees, however, all were serviceable. The eye piece of the periscope was found on the main deck, beneath the officer's booth hatch, in good order, the threads were not damaged. Damage to optics decreased in the forward turrets. The only damage to turret 5 was caused when the rangefinder carried away and sprung the housing of the periscope.

All turrets were trained and elevated in power and manual control - conditions were normal with exception of right gun in turret 4. Turrets would be able to operate in local control. Turret 4 was in condition "Y" and exposed directly to the blast and heat. Conditions within indicated that protection to personnel and ammunition is ample, disregarding radio-activity.

(b) Unprotected Mounts.

The damage to the 5"/.51 Cal. mounts in the air castles was caused by the gun port shutters. The blast caused by the gun port shutters. The blast forced the starboard in against the trainer's handwheel and sprung the drive shaft of No. 3 mount. However, when the shaft was freed the gun trained and evelated smoothly. The blast effect caused damage to the Vicker's Receiver Regulator on mount 3. The vacuum effect caused damage to Vickers Receiver Regulator on mount 6. These regulators would not affect the operation of the guns due to the director-scope's being damaged. Mounts 1, 2, 4, and 5 were operable. Optics were slightly damaged but serviceable. All 5"/51 cal. mounts could have continued within an hour if necessary.

Protection to personnel would not have been sufficient to prevent the effects of shock. This would have caused considerable delay in organized operation of these guns unless replacement crews were in standby.

All 3"/50 cal. mounts were operable. However, personnel would not have been able to withstand the blast. The mounts on the starboard side showed greater blast effects than the port side. Mount 3 was more directly exposed to the blast and heat than the other three mounts. The paint was burned and chipped. The optics were not serviceable. Replacing optic would have caused the gun to be out of action only a short period of time, but would have ruined the bore-sighting alignment.

The 40 MM mounts were operable in both power and manual. The ring sights on the starboard mount were distorted. This mount (1) would operate in local control until repair to the associated Mk. 51 director (see fire control) could be made. Mount 2 is operable in local and director control.

The damage to 20 MM guns on the foremast was limited to fire control. The guns were operable by tracer control. The Mk 14 gun sight associated with Mount 1, suffered small internal damage. The blast caused a small characteristic time error in the sight that could have been corrected by a compensating spot since the error will remain constant. This damage would not greatly impair the accuracy of firing if experienced personnel were manning the gun. The external damage rendered the sight inoperable - but not the gun since tracer control could be used. The air supply hoses were broken loose. The cast fittings snapped at the sight; these fittings were broken on every Mk. 14 sight where there was slack enough in the air hose to permit the blast to "whip" the hose. The arm of the fitting caused a greater stress than would be normal had the cast fitting been a straight line fitting. A flexible connecting end on the air hose would prevent this casualty. Ship spares do not contain this fitting and neither do tender spares, causing a whole sight to be useless because of one small spare part. To replace a broken air hose would require about five minutes - to replace a sight would require about twenty minutes. The power leads from the pump unit to the sight were broken loose at the pump and the sight. Mount 2 was protected by the foremast and therefore sustained only small shock damage to the Mk. 14 sight. Boresighting indicated that the sight moved in its bracket 3 mils to the left. Mount 3 was exposed almost directly to the blast. The Mk. 14 sight brackets were broken and the sight thrown forward to the deck. Both the sight and the pump unit were damaged severely. Mount 4 received protection from the stack and after part of the forward superstructure. Boresighting revealed an 8 mils change to the right. Mount 5 was on the starboard side of the mainmast with no protection. The Mk. 14 sight was operable destroyed internally. The air hose and powder cables were torn loose at the sight. Mount 6 had moisture in its sight preventing any tests being held. The air hose and power cables were intact. Both filaments in the reticule bulb were broken. The sight lost air pressure at the ray filter knob. The Silica Gel bottle was broken off. Mount 7 was damaged to the extent of having a broken front window and having the ray filter jammed over the optics. The air hose and power cables were intact. Mount 8 was frozen in train and elevation preventing the Mk. 14 sight from being removed without using heavy force. Due to damage to the gun and mount, it

was not possible to check this sight. The pump units and the major part of the air hoses and power cables on gun mounts on the mainmast were protected from the blast by the shield. Mounts 5 and 8 were not operable. A broken cast fitting on Mount 5 prevented train. Mount 8 was struck by a flying object and the barrel was bent in a gradual curve rendering the gun inoperable. The muzzle was about 10° out of line. The Magazines on all starboard mounts were distorted, necessitating replacement. Automatic weapon personnel would not have survived the blast.

(c) Secondary batteries of the type found on this ship, would not be found in a modern task-force. In the case of automatic weapons, the protection is not sufficient. However, the need of freedom of train and elevation for the efficient use of those weapons argues well for the sacrifice of protection. Powered ball turrets of the bomber type would make for increased safety to 20 MM personnel and would not impair the efficiency of operation. Increased high of gun shield on 40 MM mounts would constitute a hazard in low elevation angle firing. The shields on open mounts were not carried away or greatly distorted in any distance.

B. Armored Decks.

(a) The armored deck, barbettes, and hatches afforded ample protection to gunnery spaces below the main deck.

(b) The vent line to "C" group magazines was ruptured between the second and third deck. The rupture was in a curved portion of the line suggesting a decrease in tendency to rupture had the rigid structure been straight or had the vent line been a flexible line.

C. Torpedo Protection.

(a) Two of the upper blisters on the starboard quarter were ruptured by the blast. These blisters extend only 4 feet below the water line therefore they would not affect the efficiency of the ship's torpedo defense in that a hit would normally be below this level. The effects of the rupture and subsequent flooding in these blisters would be only a slight weakening of the structure and a tendency to list.

D. Fire Control.

(a) Damage to Fire Control Stations and Causes.

(1) The Mk. 50, Mod. 4 director in Air Defense forward was rendered inoperable. The supporting podestal for the associated Mk. 10 Radar Transmitter was cracked at its base by the blast, and distorted so that it inclined forward approximately twenty (20) degrees jamming the director in elevation and cross-level. The antenna was distorted beyone repair and the housing of the power drive unit was cracked about its circumference. The azimuth and zenith gyros in the sensitive element case were damaged. (Electrical circuit failures in the director train unit were evident before Test A). The Mk. 60 telescope gearing was sheared in elevation and cross-level. The rangefinder securing brackets were loose and the heat rest clamp cracked. Tests revealed duplication of the field. No other damage was evident. The after Mk. 50 director in Air Defense Aft. was rendered inoperable. This director was inoperable in power control before Test A due to failure of the azimuth gyro motor. The rangefinder was torn from its gearing in elevation and cross-level when the pedestal of the associated Mk. 10 Radar Transmitter was carried away. The M. 60 pointer-trainer telescope was not damaged. This director cannot be fully checked since it is jammed in cross-level. The computor is apparently in operating condition.

The Mk. 51 Mod. 3 directors in Air Defense forward sustained damage that would have rendered both inoperable until local repairs could be made.

The starboard Mk. 51 director and associated Mk. 15 sight show slight effect of heat. However, the optics are serviceable. The train synchros shifted about 1° 20' right. The elevating mechanism is normal. The Silica Gel cartridge container mounting flange was cracked and the air supply hose pierced, causing air supply and pressure leakage. The air supply motor was undamaged. Repairs could be made by ships company.

The port Mk. 51 director sustained very little damage. There was neither distortion from blast or shock, nor evidence of heat effects. The insulation on the supply leads was damaged by heat from burning Army equipment over the port air castle. The cables run along the overhead in the aircastle. This, however, did not render the director inoperable. This director was protected by the forward Mk. 50 director and the upper levels of the foremast.

The 3"/50 Cal. mounts on the forward port side are normally served by this director. The forward starboard mounts could fire on the bow using transmission from the port director. This inter-association of port and starboard director and mounts is of value only when one of the directors does not operate, since there are considerable limitations to the off side caused by obstructions.

The M. 51 Mod. 3 director in Air Defense aft, suffered considerable damage. The protecting shields were bent in and about the directors causing damage to material and limiting the directors in train. Because of the train limitations imposed by the protecting shields both directors are inoperable. The starboard director could be put into operation by ships company cutting away the shield and replacing the airline. Those air lines were broken off by the protecting shield. The associated Mk. 15 sight suffered a broken end windown, but the optical system was not injured. Within the limits imposed by the shield, the director transmitters operate normally in elevation and train.

The port Mk. 51 is inoperable. The shield was forced forward about the director limiting its ability to train and causing major damage to material. The pump unit was broken off its mounting and the air lines to the director was carried away by the shield. The director would train if the shield were cut away. The left balance weight was broken off. Although the end window is broken, the optical system of the associated Mk. 15 sight apparently was not damaged. There is considerable evidence of heat effect on both sight and director proper. Despite the damage suffered, the director transmits in train and elevation normally within the imposed train limits. The port Mk. 51 director would require considerable repair and replacements before it would operate normally.

The after directors normally served the after port of starboard 3"/50 cal. mounts depending upon the side of the ship it was lccated on. These directors are not inter-changeable, for port or starboard control as are the forward ones. It is probable that manpower would not be available for any extensive repair not necessary to the operation and safety of a ship that had withstood an explosion of "A" bomb magnitude.

The after Mk. 51 Mod. 3 directors had no protecting structure to deflect the blast and therefore suffered greater damage then the forward directors. Since the Mk. 50 director is not capable of assuming control, the failure of the port Mk. 51 director necessitates firing the port 3"/50 cal. mounts in local control.

The Mk. 51 Mod. 2 directors suffered damage that could be readily repaired by ships company. The major part of the damage was sustained by the associated Mk. 14 Mod. 8 gun sights. By replacing the sight the director would be capable of full control of 40 MM mount served. The starboard director suffered external damage to paint and shows effect of heat waves. The Mk. 14 sight eye-piece window and train and elevation mirrors were broken. The wiring is slightly damaged but does not prevent operation. The port Mk. 51 Mod. 2 director received its only damage from the heat of burning Army equipment. The damage received, was to supply cables in their insulation but was not sufficient enough to impair operation. The stack was toppled and rested about one (1) foot above the director, causing difficult operation due to lack of space for personnel. This director is capable of control of the port 40MM mount.

The Mk. 54 Stero Rangefinders on the altimeter platform were rendered inoperable by the blast. There was little evidence of heat effect. The protective housings were carried away on both Mk. 54 rangefinders. The elevating mechanism was sheared off the port rangefinder and the train securing pin was jammed. The mechanical gearing in the train box jammed causing the stand to be frozen in train but when the securing pin was removed the stand could be moved by pushing upon it. The handwheels, however were still inoperable. The rangefinder tube was elevated beyond the maximum

limits and jammed. Both the internal and external range scales were damaged. Neither the adjustor knob nor the lighting circuits operated efficiently. The starboard Mk. 54 was free in train and elevation, despite the stress applied when the protective shield carried away. The internal targets have shifted limiting both field and vision. Wiring was pulled loose but could be readily repaired.

To restore the efficiency of the Mk. 54 Stero Rangefinders, a complete overhaul would be necessary. The mounts would require alignment correction, to be of service to main or secondary battery fire. These rangefinders were not used for anti-aircraft fire because of elevation limitations imposed by the protecting housing. It would be highly desirable that repairs be made as quickly as possible to these rangefinders since local repairs would be sufficient for limited efficiency, and because of a major damage to the Mk. 3 fire control radar that would require Navy Yard facilities for repairs.

The Mk. 10 rangefinder mounted on top of turret 2 was carried away by the blast as was the same type mounted on top of turret 5.

The Mk. 3 main battery fire control radar was a major casualty. The blast carried the antenna away. All other damages were repairable by ships company.

All search radar antennae were carried away. There is no means of ranging for main or secondary batteries until repairs could be affected. The rangefinders could be made operable within limitations locally. However, the distortion of the superstructure would have caused inaccuracies of operations if the instruments had not been damaged.

The damage in secondary forward was negligible to the stations but the Mk. 7 Vickers director scopes were damaged beyond repair. The damage was almost identical on both port and starboard instruments. The cast bronze turntables were cracked and the director scopes were unshipped from their roller paths. The Ford range-keepers were damaged beyond repair. The loss of these directors forces the 5''/51 cal. batteries to use local control entirely.

Spot one was the most exposed main battery station. The overhead was forced down by the blast and broke off the mountings of the target bearing transmitter telescope and the director-scope. As a result of the loss of this station, targets from 100° relative to 165° (R) and from 195° (R) to 260° (R) could not be taken under direct fire by main battery control.

The "A.A." selector switch control panel in Air Defense forward was carried away disrupting communications. This would have destroyed the efficiency of associated "A.A." batteries until alternate communications could be established. This would not have carried away, if proper braces had been installed instead of having only two legs to hold the panel in place.

The VD-2 PPI unit in Air Defense forward was inoperable because of local damage and the radar antennae being carried away.

The Mk. 10 Mod. 1 computer forward, was slightly damaged. The necessary repairs could be made by ships company.

The Mk. 10 Mod. 1 computer in radar aft was not damaged. The stable element was undamaged.

The unstable conditions of the mainmast would make it impossible to fire in director control with any degree of accuracy. If the director platform was steady in an inclined position the necessary corrective spots would be too erratic to be practical.

(2) Main battery plot was not damaged in any way. Combat 1 was not damaged by Test "A". The ship could fire an accurate shore bombardment generated from optical bearing navigation on a grid coordinate chart. All radars are inoperable because the blast carried away the antennae. The units are otherwise in good condition. Replacing antennae would require Navy Yard facilities. The same conditions exist in Combat 2.

The director scope in the conning tower with associated spotting scopes could direct main battery fire forward of 100° and 260° relative.

All exposed stations on the mainmast are out of commission because of damage to individual items, or the unstable condition of the mainmast, or both. Two of the 20MM mounts, could fire by tracer control. The personnel in this area would have been about 90% destroyed by the blast.

The exposed stations on the foremast suffered less damage than the mainmast on the levels below air defense forward. All material on air defense forward level except the Mk. 51 Mod. 3 directors and all material above this level were rendered inoperative. Personnel damage would have been about 80% of the total personnel present at the time of the blast. The stations on the lower starboard levels suffered temporary damage that could be repaired by ships company. Injury to personnel on the starboard boat deck and lower signal bridge stations would have rendered the station inoperable. The greatest damage to gunnery department operation was to the exposed fire control stations.

The rate of fire of all guns could be maintained at the normal rate, but accuracy in main and secondary battery fire would have been about 40% of normal on opening fire and increasing to about 70% with spotting. This accuracy could be maintained on a given target. The accuracy of anti-aircraft batteries would have been reduced to about 70% of normal by use of tracer control. A determined air or surface attack would be fatal to the ship in its present condition.

(3) The obvious criticisms of the stations arrangement of a ship of this class are embodied in recently constructed ships. Greater strength of material and more protection for material and personnel are indicated.

E. Ammunition Behavior.

(a) Ready Service Ammunitions, locations, protections, behaviors under heat and blast.

1. Turret 1 was in condition "Z" for Test A. Loaded and plugged 12"/50 cal. projectiles were located as follows:

Gun chamber:	1 AP 1 HC	On spanning trays.
Upper shell deck:	3 AP 15 HC	Forward of hoist and on end.

Condition after Test A.

No damage sustained; projectiles were not moved from before Test A positions.

Turret 2 was in condition "Y" for Test A. The overhang hatch and right gun breech were open. The turret was trained 000° relative. Blind loaded and fuzed projectiles were located as follows:

Gun chamber:	1 AP 1 HC	On spanning trays.
Upper shell deck:	3 AP 4 HC	On end and forward of shell hoist.

Condition after Test A.

No damage was sustained; projectiles not moved from before Test A positions. This turret also contained the following 12"/50 cal. powder charges:

Gun chamber:	1	section SPD on left loading tray charged exposed.
Powder hoist:	1	section SPG in Powder hoist (powder passage) exposed.

Conditions after Test A.

No damage to either charge. These two turrets were sheltered by the superstructure to a great extent. Neither shock nor heat penetrated to any appreciable extent as evidenced by conditions

inside turrets. The upper shell deck contained one (1) box of 24 Mt Mk. 50 fuzes and one (1) box of 23 PD Mk. 29-3 fuze; no damage sustained.

Turret 3 was in condition "Z" for Test A. Loaded and plugged 12"/50 cal. projectiles were located as follows:

Gun chamber:	1 AP 1 HC	on load tray.
Upper shell deck:	3 AP 15 HC	On end forward of projectile hoist.

Condition after blast.

No damage evidenced. Projectiles were in before Able positions. This turret was trained 180° relative and exposed to full force of blast.

Turret 4 was in condition "Y" for Test A. Blind loaded and fuzed 12"/50 cal. projectiles were located as follows:

Gun chambers:	1 AP	On load trays.
Upper shell deck:	3 AP 4 HC	

Condition after Test A.

No damage sustained. Projectiles in place. 12"/50 cal. powder charges were located as follows:

Gun chamber	1 Section SPCG on load tray exposed 1 Section SPCG powder hoist in powder passage (exposed).

Condition after Test A.

No damage was sustained. This turret was trained 178° relative. The right breech and both the overhand and trainers booth hatches were open. The charge in the powder hoist was almost directly below the open trainers booth hatch. Even though the turret was directly exposed to the blast there was no appreciable damage. Damage inside the turret was evidenced, by dust on the deck in less quantity than is normal in firing.

Turret 5 was in condition "Z" for the test. The live primer in the gun was normal after the blast.

Turret 6 contained no ammunition.

Excepting the possible effect of radioactive material on ammuntion the effects were negligible. Protection to ammunition against heat and shock was adequate in all turrets.

2. Secondary battery ammunitions.

5"/51 Cal. ammunition was located as follows:

Blind loaded and fuzed. Starboard Aircastle	5 HC In fittings on outboard bulkhead fwd of #1 Mt.
	5 HC In fitting on outboard bulkhead fwd of #5 Mt.
Port aircastle	5 HC In fitting on outboard bulkhead fwd of #2 Mt.
	5 HC In fitting on outboard bulkhead fwd of #6 Mt.
Loaded and plugged. Stb'd aircastle.	5 HC In fitting on outboard bulkhead fwd of #1 Mt.
	5 HC In fittings on outboard bulkhead fwd of #5 Mt.

Port aircastle. 5 HC In fittings on outboard bulkhead fwd of #2 Mt.

5 HC In fittings on outboard bulkhead fwd of #6 Mt.

Condition after Test A.

No damage; all projectiles remained in fittings.

Powder Charges.

Port: 5 tanks in powder rack inboard of #4 Mt.

Stb'd: 5 tanks in powder rack inboard of #3 Mt.

Condition after Test A.

There was no damage to powder charges. All tanks were there in before Able positions. The paint on the overhead and inboard bulkheads indicate sufficient protection from both heat and blast. In the event that these samples did not receive the indicated protection the SPCG powder is proven extremely stable. However had the point of detonation been 090° or 270° relative it is probable that the projectiles would have been thrown on the deck increasing the possibility of detonation by shock and heat. The probable eventualities of a detonation would include fire and further explosion in the immediate area with possible detonation of 40 MM and 3''/50 Cal. by sympathetic explosions. Heavy casualties to both personnel and material in the area would have resulted had an explosion of the powder or projectiles occurred.

3''/50 Cal. ready service locker - Locations:

2 boxes (one) port and stb'd. Fr. 43 boat deck outside Captains cabin and office.

4 boxes (two) port and stb'd. Fr. 51 boat deck just aft of Captains cabin and office.

2 boxes (one) port and stb'd. Fr. 51 main deck forward of turret #3.

1 box stb'd. Fr. 102 on quarter deck, main deck.

The 3"/50 Cal. ready service lockers at Frame 75 and 101 starboard on the main deck had the sun shield blown off and all sides dished in except the door by the blast. Ten of the 24 rounds of service ammunitions had the case crumpled by the locker side when they were forced in. These rounds would probably cause plug casualties if they were fired. The remaining fourteen rounds were not damaged. The 3"/50 cal. ready service lockers on the port side of the boat deck level at frame 51 were exposed to heat and flame from burning Army equipment. The paint on the locker was blistered, but the ammunition was not damaged. A maximum temperature of 125° was recorded. There was no damage to other 3"/50 Cal. ready service lockers.

3. 40MM ready service ammunition locker - locations.

Port and starboard clipping rooms at Fr. 47 lower signal bridge.

Port and starboard clipping rooms at Fr. 57 boat deck.

The 20MM ready service ammunition suffered no damage from Test A.

20MM ready service ammunition lockers - Locations.

2 boxes port Fr. 39 on main deck.
1 box port Fr. 43-1/2 boat deck.
2 boxes (one) port and stb'd Fr. 60 boat deck.
2 boxes large (one) port and stb'd Fr. 49 lower signal bridge.
1 box port Fr. 46 lower signal bridge
2 boxes (one) port and stb'd Fr. 75 main deck, fwd. of turret #3.

The 20MM ready service box at frame 75 starboard side of main deck was damaged by the blast. The sun shield was torn loose and the sides dished in. However the ammunition inside was not damaged. This ready box contained 360 rounds not in magazines. Had this ammunition been in magazines about 50% of the magazines probably would have been damaged. The maximum temperature registered in service lockers was 104° excepting the 3"/50 Cal. locker exposed to fire. The penetration of heat was negligible. It is probable that no damage would have been sustained to ready service lockers had they been of spherical outside construction.

(b) All below decks ammunitions storages were normal. The rise in temperature was expected when the ventilation system was shut down. The "D" (D-19-S) magazine group 40MM storage was flooded by water from steering aft via a common drain whose outlet was closed for Test A. When the valve was opened the water drained to the bilges. There was no damage to the ammunition. The S.P. samples were normal.

(c) All below deck stowages are sufficiently protected.

F. Ammunition Handling.

(a) Condition and operability of ammunition handling devices.

(1) The left projectile hoist in turret 6 was inoperative before Test A. The controller was inoperative. No damage was caused by Test A. All ammunition handling devices are operable except above mentioned hoist.

(2) The secondary battery ammunition hoist sustained no damage in Test A.

(3) The only passing scuttles are located in turrets. There was no damage to these scuttles.

(4) Not Applicable.

(b) Heat did not penetrate the protective armor to any appreciable extent as evidence by the maximum temperature found in the lower handling room of the turrets.

Turret	L.H.R.	Max. Ave. Temp.	Ave. Temp. at time of entry	Condition of Turret
Turret #1	L.H.R.	94.3°	89.6°	Z
Turret #2	L.H.R.	91.2°	88.8°	Y
Turret #3	L.H.R.	99°	94°	Z
Turret #4	L.H.R.	95.5°	90°	Y
Turret #5	L.H.R.	93°	89°	Z
Turret #6	L.H.R.	91.5°	87°	Y

The normal average temperature of lower handling room in this area is 87°. For heat to penetrate from the gun chamber to the lower handling rooms of the turrets the major part must pass through the auxiliary shell hoist and scuttles outboard of power hoist. A part of the indicated temperature rise was expected when the ventilation system was shut down. It is estimated that a 3 to 5 degree rise in temperature was due to penetration of heat from the explosion, and that a major part of this heat passed to the lower handling rooms via powder passing scuttles and the auxiliary shell hoist. It is not believed that a spring trap passage would greatly reduce the effects of a flash heat such as was sustained in this test. Since there was only a 2 to 3 degree variation in the temperature of the lower handling rooms of "Z" and "Y" turrets.

There was no indication of blast inside the turrets that could have been associated with transmission via scuttles or hoist. There was no damage to the ammunition hoist serving secondary batteries and automatic weapons. Nothing was found to indicate transmission of heat or blast via these hoist.

All ammunition handling devices withstood the forces of Test A in a manner that indicates no construction or design changes are necessary for this class ship.

SECTION III

PART C - INSPECTION REPORT

SECTION C - MACHINERY

INDEX

A. General Description of Machinery Damage.

The only vital damage done by the Atomic Bomb to the machinery plant of the U.S.S. ARKANSAS was to blow the stack off and to rupture and distort the casings of boilers # 2, 3, and 4. Boiler #1, the main forced draft blowers, the fuel oil and feed water equipment, the main turbines and reduction gears and their associated auxiliaries, all condensers, the propellers and shafting, the main generators and their associated auxiliaries, the emergency diesel generators, the steering engine and the anchor engine, the main and emergency distilling plants, the main refrigeration machinery, machine ship equipment, ammunition hoists, all pumps and compressors, and all piping systems (with a few exceptions) suffered no damage.

On the weather deck level, in addition to the loss of the stack, the force of the explosion lifted and rotated the starboard crane making it inoperative, caused a structural distortion in the galley deck house structure which resulted in the rupture of the fresh water and steam lines to the galley and the flushing water lines to the boat deck head, and dished in the after deck causing structural damage to the after deck winch and rendering it partially inoperative. One of the two motor whale boats stowed in skids on the boat deck was missing; the other was blown clear off the sids and wrecked although the motor would still run.

On the second deck level, the flushing system carried away in the crews head aft as a result of distortion of the ships hull in that area. In the laundry, a pipe fitting failed on a steam line and on a fresh water line. Both lines were suspended from the overhead.

On the third deck level, the flushing supply line to the crew's head was ruptured at frame 125 as a result of distortion to the ship hull. Two small pipe fittings leaked in the distilling plant.

Below third deck level, there were two cracks in the auxiliary exhaust line piping. One was in a section of line piercing the longitudinal bulkhead between the port and starboard engineroom. One leg of the tripod mast rests on this bulkhead and it was distorted below that place. The other crack was in a bend of the exhaust piping from the starboard main circulator.

With the exception of the damage to the flushing system in the crews head aft all piping damage was negligible and easily repaired by ships force. No piping damage suffered would have made any change in the operation of the engineering plant.

The only damage to ventilation machinery occurred as a result of structural deformation of the hull or bulkheads. On the second deck, in the area of crews head aft, two ventilation motors were out of line and had bent shafts, and a third had the foundation bolts sheared and was displaced from its base. On the third deck in the same area, one ventilation motor was out of line with a bent shaft. A wire pulled loose from a topside ventilation motor on radar aft as a result of a buckled bulkhead. This was the entire damage to ventilation machinery. The topside closures to ventilation sets 3-80-1 supply and 3-113-1 supply were left open during Test A. Vent ducts were blown out on these sets but motors and impellers were unharmed.

A detailed description of the damage to boilers is given in the following section of this report (Item B). The only damage of significance that occurred was to the casings. Plastic and brickwork movement of a very minor nature occurred in boilers 1, and 3 and five air register flaps blew out in boiler #1. Boiler #3 was the most severely damaged; boiler #4 was the least damaged.

While it is obviously impossible to predict exactly what the damage would have been if the same bomb were dropped in the same place with all boilers lighted off and way on the ship, it is believed that certain conclusions can be drawn as to possible damage.

It is not believed that personnel in the fireroom would have been injured beyond possible flash burns if they were in their operating stations. Personnel standing alongside casing panels

when they blew out would probably be severely burned and would be injured where struck by the casing. It is believed that the flaps on the air registor would operate satisfactorily to prevent excessive flare out in front of the boiler, and that the forced draft blowers would operate to hold the fires in the boilers after the blast.

There was no evidence in the firerooms of high temperature or of shock effects other than the blown out boiler casings. Objects such as coffee cups and wrenches which were left on work benches by the boilers were unmoved. No boiler gage glasses or gages were broken.

It is believed that ARKANSAS could steam without a stack if placed in the wind so that exhaust gases would not be sucked into forced draft blower and ventilation ducts. Assuming this done, it is believed that with the boiler damage sustained, that the forced draft blowers could supply enough air and that boilers could carry fires as follows:

Boiler #1 - Six burners.
Boiler #2 - Possibly two or three inboard burners.
Boiler #3 - No burners.
Boiler #4 - Five burners.

Under these conditions it is believed that the ship could proceed with a speed of about ten knots.

It is not believed that steam pressure would have been lost as a result of the test. The fires would have been extinguished only momentarily and would have been relighted immediately as the fuel oil system would have continued to supply oil to the burners. There would be some possibility of flareback but it is believed that an experienced water tender of the watch would have increased air pressure and cut out burners to prevent this.

It is estimated that emergency repairs could have been made in about one hour on boiler #4 and in about two to three hours on boiler #2 by pushing the casings back in place and covering them with

asbestos cloth. The air pressure would serve to hold the cloth in place. The mud drum lagging was blown off boiler #3 so that it would have been necessary to relag the mud drum before putting the casing back into place and covering with asbestos cloth. It is estimated that this could have done in five or six hours.

Having the limitations of an accurate predictors well in mind, these observations are summed up to state that the ship could have continued underway at a speed of about ten knots without loss of steam pressure. Personnel damage would have been slight and emergency repairs would have been completed in about six hours.

B. Boilers.

The only vital damage to the engineering plant as a result of Test A, occurred to the boilers. The smoke stack was blown off, and the casings were blown out and distorted on boilers #2, 3, and 4. The casing was not damaged on boiler #1. Apart from casing damage, there was no other damage to any of the boilers except for slight plastic refractory movement and the blowing out of five air registor flaps in boiler #1, and slight movement of brick-work in boiler #3. This damage was so slight that it may be entirely discounted as far as maximum steaming power is concerned.

The boilers were left in the following condition for Test A.

Boiler #1 - Secured. Water at steaming level.
Boiler #2 - Secured. Safety valves gagged.
Hydrostatic pressure of 295 psi applied.
Boiler #3 - Secured. Safety valves gagged.
Hyrostatic pressure of 295 psi applied.
Boiler #4 - Secured. Water at steaming level.
Left under steam pressure. Pressure boosted to 275 psi before leaving ship.

On returning to the ship, pressure on all boilers was zero. Prior to Test A, a hydrostatic test of 295 psi was applied to all boilers. The longest period taken for the pressure to fall to zero was nine hours. The same test was applied after Test A, with comparable results.

A stack five feet in diameter and twenty five feet high was fabricated and placed over the uptake for boiler #1 at the place where the smoke pipe was blown off. This uptake was square, measuring six feet to the side, so the stack cross sectional area for the boiler as well as the height was decreased. Uptakes for boiler #2 were blanked off. Boiler #1 was lighted off 9 July 1946 and has continued to furnish steam for the ship since that time.

A discussion of the effect of the boiler damage on the operation of the engineering plant is discussed under General Description of Machinery Damage (Item A). A detailed description of the damage to each boiler follows.

Boiler #1

Boiler #1 was undamaged except for a slight loosening of the plastic refractory at the peak of the boiler front and back walls, and for five air register flaps which blew outwards.

The damage to plastic refractory was so slight as to be almost entirely negligible. It would in no way effect the steaming of the boiler even at full power. It was repaired in about an hour by ship's force, the old plastic being torn out and new installed.

These boilers are each equipped with eight Lodi air registers. One flap in each of air registors #1, 4, 6, 7, and 8 blew outwards the end springing past the retaining stop. These flaps were sprung back into place manually and now operate satisfactorily. This damage would have in no way affected steaming the boiler. This was the only boiler to which this type of damage occurred.

Boiler #2

Boiler #2 was undamaged except for ruptured and distorted casings.

The inboard casing was intact except for a slight bulge outward and a few casing flange bolts pulled loose at the lower corner of one of the sections of the upper casing panel. Leakage from this distortion alone would have been negligible and would not have reduced the boiler's steaming capacity.

On the outboard side, the side casing panel was blown almost entirely off the boiler, being held only by the forward and after vertical seams. The two short sections at the forward and after ends of the upper casing panel were blown outwards and the remainder of the panel was dished in, the lower seam being about six inches from the boiler tubes.

The uptakes for boiler #2 were bulged out on all four sides on the third deck level. Maximum distortion occurred on the inboard side, the center of the side being about six inches from the normal plane. All corner seams held and leakage would have been negligible.

Boiler #3

Boiler #3 was undamaged except for ruptured and distorted casings and a slight displacement of two rows of brick-work.

The outboard mud drum wrapper was ruptured along both end seams, and vertically up the center, with one half of the wrapper ruptured along the bottom seam; thus making one section blown up and out, and the other blown down and out. The upper and lower outboard casings were dished in the center, making a half oval shaped depression.

The inboard mud drum wrapper was ruptured along one end seam and along almost the entire length of the top and bottom seams. The wrapper was blown well clear of the mud drum, bending at the ruptured end. The upper and lower inboard casings were dished in the center, making a half oval shaped depression.

The two rows of boiler brickwork next to the "A" row of tubes on the inboard side of the boiler front were slightly displaced. This damage would not affect the steaming capacity of the boiler and could be repaired by ship's force in a short time.

Boiler #4

Boiler #4 was undamaged except for ruptured and distorted casings.

On the inboard side, the side casing was ruptured along its entire lower seam and for about half of one vertical end seam, allowing the lower edge to swing out for about four inches. The upper and lower boiler casings were slightly dished in the center making a half oval shaped depression.

On the outboard side, the side casing was ruptured along its entire lower seam and for almost the entire length of each vertical end seam, allowing the lower edge to swing out for about eight inches. The upper and lower boiler casings were slightly dished in the center, making a half oval shaped depression.

C. Blowers.

No change was noted in the forced draft blowers, the forced draft blower flaps, on the fireroom air locks as a result of Test A.

There are four forced draft blowers for each fireroom. Before Test A, each group of four was tested, running the blowers singly, in pairs, in threes, and all together. Various air pressures were maintained up to 8" of water. This test showed that the blowers of each group would run at equal speeds in all combinations. This test was repeated after Test A, with the same results. Positive speed limiting governor action was noted on all blowers when running at highest capacity.

The forced draft blowers in #1 fireroom have been alternated in operation since that fireroom was lighted off.

D. Fuel Oil Equipment.

No change was noted in fuel oil equipment as a result of Test A. All pumps in the fuel oil system were operated and a working pressure test was applied to all fuel oil piping. A test of 450 psi (relief valve lifting pressure) was applied to the fuel oil heaters and the discharge piping through the burner manifold. The system has been in continuous operation since steam was restored to the ship.

E. Boiler Feedwater Equipment.

No change was noted in boiler feedwater equipment as a result of Test A. All pumps in the feedwater system were operated and a working pressure test was applied to all feedwater piping. The system has been in continuous operation since steam was restored to the ship.

F. Main Propulsion Machinery.

No change was noted in any of the main turbines as a result of Test A. The main propulsion plant was lighted off using routine lighting off procedure. This allows about three and one half hours to warm up the main turbines during which time they are jacked over for about two hours with the electric jacking gear. The turbines were tested satisfactorily and spun ahead and astern five times. A vacuum of 27" of mercury was maintained. Hot and cold dummy micrometer readings were taken, showing normal axial clearances. The main propulsion plant was then secured using routine securing procedure.

Three sets of lead readings were taken on the forward bearing of each main ahead turbine. One set was taken before Test A, one set was left in place for Test A, and the readings taken thereafter, and a third lead reading was taken after the second set was removed. New leads will be left in place for Test B, and a similar set of readings recorded. Comparison of these readings seems to indicate that the forward end of each propeller shaft moved upward and then resumed its original position during Test A.

G. Reduction Gears.

No change was noted in the main reduction gears as a result of Test A. Reduction Gear inspection plates were removed and the gears were inspected while being turned by the electric jacking gear. Main engines were warmed up and the reduction gears were turned by the electric jacking gear for a period of about two hours. Main engines were spun ahead and astern by steam several times and then secured.

H. Shafting and Bearings.

No change was noted in the propeller shafting, spring bearings, bulkhead packing glands, and stern tubes as a result of Test A. The shafts were turned and inspected while testing main turbines. The forced lubrication system supplying the spring bearings operated normally.

Leads taken on the forward bearing of each main ahead turbine seem to indicate that the forward end of each propeller shaft moved upward and then resumed its original position during Test A. A discussion of this test is included under Main Turbines (Item F), and a copy of the lead readings is appended.

I. Lubrication System.

No change was noted in the main lubrication system as a result of Test A. All pumps were operated and a working pressure test applied to all piping and fittings. Lub-oil purifiers operated satisfactorily. The system was used in testing reduction gears and warming up main engines and has been used in the routine daily jacking of main engines.

J. Condensers and Air Ejectors.

No change was noted in the main condensate system as a result of Test A. The main engines were warmed up and spun by steam. A vacuum of 27" Hg was put on both main condensers. The salinity of the condensate was normal.

No change was noted in the dynamo condensate system as a result of Test A. The dynamo plants have alternated in operation since steam was restored to the ship.

The injection and overboard valves were left open on the port main condenser and the forward dynamo condenser during Test A. The tubes in all main and dynamo condensers, with the exception of the starboard main condenser, are over-age and pitted and require frequent plugging. However, no leakage was found after Test A.

K. Pumps.

No damage to any of the pumps aboard the ship was noted as a result of Test A. All pumps were tested and operated at working loads and pressures and have been carrying out their normal function since steam and electrical power was restored to the ship.

L. Auxiliary Generator. (Turbines and Gears).

No change was noted in the main turbo-generator sets as a result of Test A. The dynamo plants were put into operation when steam was restored to the ship and have alternated in supplying electrical power and lighting to the ship since that time.

M. Propellers.

No visual examination was made of the propellers. However, the main engines were turned with the jacking gear and spun by steam and the shafting, reduction gears, and turbines showed no evidence of vibration.

N. Distilling Plant.

The port and starboard main distilling plants were put into operation when steam was restored to the ship and have continued in operation since that time.

Two minor items of piping damage occurred to the starboard main distilling plant as a result of Test A. Neither would impair the normal operation and output of the plant. The air ejector steam supply drain line (1/4'' steel) cracked at a nipple on a vertical load about seven feet above deck. A 1-1/4'' silver soldered fitting on the air ejector condenser emergency overboard line cracked where the line joined the air ejector condenser. This fitting showed evidence of previous corrosion. Both items were repaired by ship's force.

The emergency distilling plant was operated for a period of four hours and showed no change as a result of Test A.

O. Refrigeration and Air Conditioning Plants.

No change was noted in the main refrigeration plant, as a result of Test A. The main refrigeration plant has been in continuous operation since steam was restored to the ship.

No change was noted in any of the scuttlebutts or refrigerators as a result of Test A. These units are all operable.

No change was noted in any of the three air conditioning units as a result of Test A. All units are operable.

P. Winches, Windlasses, and Capstans.

No change was noted in the a chor engine, wildcat, spindles, or wildcats as a result of Test A. The anchor engine was put into operation and anchor chain was raised and lowered.

No change was noted in the forward deck winch as a result of Test A. This winch operated normally under load after return to the ship.

The after deck winch suffered considerable damage as a result of the movement of ship's structure. The unit as a whole was lowered as the deck in the vicinity was depressed about thirty inches. The starboard shaft bearing base was cracked, the starboard

shaft was slightly warped, and the foundation for the motor was cracked. The motor and the port shaft and bearing were undamaged. The unit as a whole would turn over under no load but would not operate under load due to misalignment of the starboard shaft. The flange connecting the starboard shaft was broken and a load test was applied to the port shaft and drum. Under these conditions the port drum was found to be able to operate satisfactorily under a load of 3-1/2 tons.

Q. Steering Engine.

No change was noted in the steering engine and the steering control system as a result of Test A. The steering engine was put into operation and the rudder moved over maximum range . from all steering control stations, using the telemotor system, wheel ropes, and trick wheels. The rudder was also moved over maximum range by hand steering and the emergency steering motor.

R. Elevators, Ammunition Hoists, Etc..

No change was noted in any ammunition hoists as a result of Test A. All ammunition hoists were operated in a no load test with the exception of the left projectile hoist in turret 6. This projectile hoist was inoperative before Test A because spare parts were not available to repair a defective controller for the hoist motor.

S. Ventilation (Machinery).

There was no damage to any ventilation machinery except in the area in the extreme stern where deformation of the ships structure caused by the bomb blast resulted in damage to ventilation motors. The following vent sets were damaged as indicated:

(1) 2-124-2 Supply - Motor out of line, shaft bent, result of surrounding structural failure.

(2) 2-124-2 Supply - Motor out of line, shaft bent, controller displaced, base displaced from foundation; bolts sheared, result of surrounding structural failure.
(3) 2-125-2 Exhaust - Motor out of line, shaft bent, result of surrounding structural failure.
(4) 3-122-CL Supply - Motor out of line shaft bent, result of surrounding structural failure.
(5) 1-102-2- Broken wiring load to motor, result of displaced bulkhead.

It is of interest to note that two ventilator systems were left open during Test A, and the motors and fans were undamaged although the ducts were blown out. These systems were 3-80-1 supply and 3-113-1 supply, both had centrifugal type fans.

T. Air Compressors.

No change was noted in any air compressors or compressed air systems as a result of Test A. All air compressors were operated and all compressed air systems were tested at working pressure.

U. Diesels. (Generators and Boats).

No change was noted in the emergency diesel generators as a result of Test A. These generators were put into operation when Team Baker returned to the ship and remained in operation, supplying ship's light and power, until steam was restored to the ship.

For Test A, the motor whale boats were left in the boat skids on the port side of the boat deck. After Test A, #2 motor whale boat was missing and #1 motor whale boat was blown clear off the skids. There was a hole in the boat and the propeller shaft was bent. One terminal lug of the starting battery was broken. The exhaust line carried away at the manifold. However, the engine was started and operated satisfactorily.

No change was noted in the diesel fire pumps as a result of Test A. These pumps were put into operation when Team Baker returned to the ship and remained in operation supplying fire-main pressure until steam was restored to the ship.

V. Piping Systems.

All piping systems aboard the ship were operated under working pressure and no damage was noted except as listed below. All damage to the piping systems was of a minor nature and would not have interferred with the operations of the ship or of the piping system as a whole. The greatest damage occurred in the crew's head where the flushing water system ruptured and carried away, and in the galley where fresh water and steam lines were ruptured. A resume of failures by systems follows:

(a) Auxiliary exhaust piping.

(1) Auxiliary exhaust cross-connection line between port and starboard enginerooms had a 3" crack in the port engine-room about one inch from bulkhead flange. A pressure was exerted on the longitudinal bulkhead separating the enginerooms by a leg of the tripod mast. This leak would not have interferred with normal steaming. Repairs were made by ship's force.

(2) Auxiliary exhaust line from starboard main circulating pump had a 2" crack in a bend from the pump. The crack originated from an old crack that had been repaired. This would not have interferred with normal steaming. Repairs were made by ship's force.

(b) Flushing system piping.

(1) Flushing system piping was ruptured in crew's head aft. This area is easily isolated. A jury rig was made by ship's force and complete repairs could have been made in a few days.

(2) The same condition existed in the boat deck head and the same steps were taken.

(c) Fresh water piping.

(1) Fresh water piping to the galley was ruptured. This was easily isolated and repairs made by ship force.

(2) An elbow on the fresh water supply line to the laundry was cracked at frame 103. This line is suspended from the second deck overhead. This line is easily isolated. Repairs were made by ship's force.

(d) Constant and intermittant steam service lines.

(1) All galley steam lines were leaking. These steam lines are easily isolated. Repairs were made by ship's force in one day.

(2) The steam supply line to #1 washing machine leaked at a reducer. This line is suspended from the second deck overhead. Repair was made by ship's force.

(e) Distilling plant piping.

(1) A silver soldered brass fitting connecting an emergency salt water overboard line to an air ejector condenser leaked. This would not affect operation of distilling plant. Inspection showed evidence of previous corrosion. Repair was made by ship's force.

(2) A nipple on the steam drain line from the air ejector steam supply line leaked. This would not affect operation of distilling plant. Repair was made by ship's force.

W. Miscellaneous.

No damage to the machine shop was noted as a result of Test A. All machine shop equipment was operated and found to be in alignment.

No damage to the laundry machinery was noted as a result of Test A. An elbow in a fresh water line and a reducer in a steam line failed as a result of movement of the ship's structure. These were repaired by ship's force. The laundry has been in continuous operation since steam was restored to the ship.

The force of the explosion lifted and rotated the starboard crane making it inoperable. The port crane was put into operation.

SECTION III

PART C - INSPECTION REPORT

SECTION D - ELECTRICAL

INDEX

A. General Description of Electrical Damage.

Taking the overall view, electrical damage to the U.S.S. ARKANSAS was slight as a result of the Test A, atomic bomb explosion. Practically all the damage occurred above the weather decks and was the result of equipment and wiring being directly exposed to the shock and blast effects of the bomb, or to derangements incurred by movement and deformation of the ships structure. The only damage below decks was on the second deck at the stern where movement of the ships structure caused mechanical damage to four ventilation motors and displaced some cable and electrical fixtures. Since it is believed that steam pressure would have been maintained on the ship after the explosion, the main generating plant would have continued to supply electrical power and lighting and the ship's operation from an electrical point of view would have been virtually unchanged.

The ship's running lights, anchor lights, and vertical fighting light were rendered inoperable by the blast. The transmitters for the wind intensity and direction indicating system (HC-HD) were missing from the foremast. Three 1 MC reproducers were missing, one from the foremast, one from the mainmast and one from the boat deck house structure. The starboard thirty-six inch searchlight was blown from its platform to the main deck. The port thirty-six inch searchlight was damaged, one trunion arm being broken, the glass dome shattered, and the iris shutter inoperable, but the lamp mechanism was undamaged and could be operated. Both trunion arms of the twenty-four inch searchlight were broken, the glass dome was shattered, and the sides of the barrel were dished, but the lamp carriage and the lamp were unaffected. Of the eight twelve inch searchlights, three on the port side of the signal bridge were undamaged, one on the statboard side of the signal bridge was undamaged except for some wiring which was burned slightly, two on the starboard side of the signal bridge were blown off, and the two on the mainmast were structurally damaged and had light filaments broken. The magnetic compass was blown from its stand to the deck below. The rangefinder sight lighting battery was badly

damaged. One motor whale boat was missing and the starting battery in the other had one broken terminal lug. The battery locker suffered considerable structural damage and one rack of batteries was thrown on deck causing breakage and spilage of acid. The starboard crane was mechanically damaged so that it could not be moved but the crane motors appeared unharmed. The after deck winch motor had displaced and broken studs in its base mounting, the drum controller was displaced, and about thirty per cent of the cast iron grids for the starting resistance were broken. The grids were replaced and the motor operated satisfactorily. A rotary selector switch for sound power circuits at A.A. defense forward was broken but still operable. The 1 MC transmitter in the O.O.D.'s booth was distorted structurally, had two bakelite terminal blocks broken and the volume indicator blown in, but was still operable. Cable was of course disconnected on all missing items and displaced where the structure on which it was mounted had moved. Painted cable was unharmed but one section of unpainted cable on the foremast seemed to have insulating material ooze through the armor sheath. A sample of this cable was removed and sent to BUSHIPS. No electrical damage occurred to any of the electrically operated galley equipment although distorted structure caused mechanical damage.

On the second deck level in the vicinity of the crew's head the shafts were bent and the motors were out of line on three ventilation units. One of these motors had foundation bolts sheared and the control box was loose from its mountings. These motors were operated. One ventilation motor in the area immediately below on the third deck was out of line and had a bent shaft but was operable.

Approximately three pounds of mercury was spilled from the flotation bowels of the forward master gyro compass; a few drops were spilled from the after master gyro compass. Both compasses were put into operation. The difference in reading was .2 degree.

B. Ship's Service Generators.

No change was noted in the ship's service generators as a result of Test A. They were put into operation as soon as steam pressure was restored to the ship and have continued to carry the ship's electrical load since that time.

C. Emergency Generators.

No change was noted in the diesel emergency generators as a result of Test A. These generators were put into operation when Team Baker returned to the ship and continued in operation, furnishing ship's light and power, until steam was restored to the ship and the main generators started.

D. Switchboards and Distribution Panels.

No change was noted in any switchboards or distribution panels as a result of Test A. All switchboards and distribution panels were energized and ground readings were taken on all circuits.

E. Wiring, Wiring Equipment and Wireways.

Damage to cables was slight in exposed areas on masts and weather deck spaces. Where exposed cable had been painted, no damage was noted; however, certain sections of unpainted cable were observed to have insulating material oozed through the armor sheath. A sample of subject cable was removed by a representive of BUSHIPS for further inspection.

In areas of structural damage, some cable was displaced from its associated equipment or bulkheads. In a few instances the cable had been broken by stress as a result of damage to its mounting structure.

Below the weather deck no damage was noted except in the vicinity of the after crew's head where a few cables had been displaced as the result of deformation of ships structure.

No damage was noted to wireway supports. Connection and junction boxes receptacles and plugs were undamaged except for a few boxes that were in an area of structural damage.

F. Transformers.

No change was noted in L.C. transformers as a result of Test A. They have been in continuous operation since electrical power was restored to the ship. There are no lighting transformers installed aboard this ship.

G. Portable Batteries.

No damage as a result of Test A, was noted to the starting batteries for the forward and after diesel generators, nor to the ship's service telephone battery. These units were all operated.

Damage as a result of Test A, did occur to the rangefinder sight lighting battery, to diesel starting batteries for the motor whale boats, and to certain of the spare batteries in the battery locker.

The rangefinder sights lighting battery, located on the rangefinder platform at frame 54 C.L. had broken cases on both trays, cells loose in all cases, and plates and terminal post of one cell missing. Blast effect was considerable in this area, the rangefinder cover being blown entirely off.

The motor whale boats were stored in skids on the port side of the boat deck. After Test A, the outboard boat was missing and the inboard boat was blown off the skids. The starting battery for this boat was loose in the box, the head of one tray had several cracks, and the positive terminal lug on one tray was broken. However, when this terminal was connected the diesel boat engine started with this battery.

Batteries were stored in two racks in the battery locker. This locker had considerable structural deformation. The strap holding the batteries in the top rack came loose and the batteries were thrown out. Acid was spilled and cells were loose, cracked, and broken. The batteries in the lower rack were undamaged.

H. Motors, Motor Generator Sets, and Motor Controllers.

In general, motors throughout the ship were not affected by Test A. The starboard crane motors were not operated due to misalignment of mechanical gearing. However, insulation tests and visual inspections indicated that subject motors were in an operable condition. The after deck winch motor had two base studs displaced and the remaining two studs were loosened. The drum controllers mounted on the second deck for this motor was displaced from its rack. About 30% of the cast iron grids for the starting resistance were shattered. Subject grids were renewed and the motor tested satisfactorily.

All ventilation motors except four operated satisfactorily. These four motors located in the vicinity of the after crew's head were operated but condition indicated that the impeller shafts were bent.

All other motors aboard the ship were unaffected by Test A.

I. Lighting Equipment.

In general, all lighting throughout the ship except ships running and anchor lights and vertical fighting lights was unaffected by Test A. Even in the air castles and in the vicinities of the worst structural damage, lighting circuits were energized and nearly all of the lamps burned. In some cases, lamps had become loosened in sockets, but when secured again they functioned.

Fluorescent lighting installed in offices and staterooms on the second and upper decks showed no change. The same was true in below deck spaces such as the plotting room, the I.C. room, the log room, and the barber shop.

In the vicinity of the after crew's head on the second deck there were a few glass globes and lamps broken and in some cases only the filament was broken.

No fixtures were noted to have been displaced although in some cases mounting screws were loose. Pondant lamps holders were unaffected.

The ship's running and anchor lights, and vertical fighting lights were all inoperable. Structural failures and moving objects caused cable to be broken and glass to be shattered.

J. Searchlights (36", 24", and 12").

Two 36" searchlights were mounted on the 04 platform in the mainmast. The starboard searchlight was blown from the platform and crashed on the main deck. The cast aluminum trunnion arms for the barrel had been broken on both sides. The glass dome and barrel had been shattered in many pieces, but the steel reflector was missing. The lamp mechanism was only slightly damaged. It was removed to the shop and the feed motor energized. Both the positive and negative feed mechanisms functioned satisfactorily. The port 36" searchlight was still remaining on the platform. The cast aluminum trunnion arm was broken on one side and the glass dome was completely shattered. The iris shutter had been displaced and was inoperable. The lamp mechanism was undamaged. The arc was struck and operated satisfactorily for a thirty minute uninterrupted period.

The 24" searchlight (only one on the ship), equipped with a 1000 watt incandescent lamp, located on the 05 platform in the foremast had its cast aluminum trunnion arms broken similiarly to the 36" searchlights. The sides of the barrel were dished and bent the dome glass broken, but the reflector remained intact. Neither, the lamp carriage nor the lamp were affected. The manually operated signal shutter mechanism operated satisfactorily. Temporary repairs could have been effected within six or eight hours and placed searchlight again in operation.

Two 12" incandescent searchlights were mounted on the main mast and three on each side of the signal bridge on the foremast. These on the mainmast were not displaced from their mounting but the supporting brackets were cracked and bent. Barrels were dished and distorted, hinges bent, lamp filaments broken, but the manual shutter mechanism functioned satisfactorily. The three installed units on the port signal bridge were undamaged and were all operated after reboarding. On the starboard side of the signal bridge one searchlight was intact and undamaged except that the rubber covered electrical cable had been burnt into by fire in that area. One unit was lying on deck nearby. The barrel was slightly distorted, hinges bent, lamp filament broken, but the shutter mechanism was undamaged. The third unit was blown to the main deck about one hundred feet from its original mounting. The impact had nearly demolished this searchlight. The barrel was dished, lamp broken, hinges bent and the shutter mechanism inoperable.

K. Degaussing Equipment.

No change was noted in any of the degaussing equipment as a result of Test A. Degaussing motor generator sets were put into operation, degaussing circuits energized, and rheostats operated both locally and remotely.

The magnetic compass was thrown from its stand to the deck below. The compass compensating coil and the associated wiring were shaken loose but the coil frame was unbroken.

L. Gyro Compass Equipment.

As a result of Test A, approximately three pounds of mercury was spilled from the flotation bowl of the forward master gyro compass and a few drops were spilled from the flotation bowl of the after master gyro compass. Both compass were started. The difference in reading was .2 degree.

Only two gyro repeaters were damaged. The repeater located at Batt II (mainmast) had the glass dial face shattered,

the dial bent and deformed, and internal wiring deranged so as to cause a zero ground. The repeater located in secondary forward came adrift from its mounting (Arma Mark VIII Mod. 2), but was otherwise undamaged.

No change was noted in the dead reckoning tracer as a result of Test A.

M. Sound Powered Telephones.

No headsets or handsets were noted to have received any damage. Stowage boxes were found to be intact and unchanged. Only in cases of structural failures were any jack boxes or selector switches noted to be damaged and these were comparatively minor. At the forward A.A. defense station the aluminum housings of two selector rotary switches were broken as the result of faulty mounting on a light metal shield. However, this did not render the switches in operable provided the entrance of moisture was prevented.

N. Ship's Service Telephones.

No damage was noted to the ship's service telephone system as a result of Test A. It was energized as soon as electrical power was restored to the ship and has been in continuous operation since that time. No telephone sets, either bulkhead or desk type, were injured.

O. Announcing Systems.

Damage to announcing systems as a result of Test A, was slight. Three topside 1 MC reproducers were missing, two below decks 1 MC reproducers were loose from their mountings but were still operable, and a 1 MC transmitter was damaged but still operable. No other damage was noted to announcing systems.

One of the topside 1 MC reproducers that was missing was located on the mainmast, one on the port side of the foremast, and one at the 03 level on the boat deck house structure at frame 72.

The two 1MC speakers which were loose from their mountings were located on the second deck in the after crew's living space and in the crew's head aft. The speakers were operable and were placed back in the mountings.

The 1 MC transmitter in the O.O.D.'s shack on the main deck was distorted structurally, two bakelite terminal blocks were broken and the volume indicator was blown in, but was still operable.

P. Telegraphs.

No damage was noted to any of the telegraph systems as a result of Test A. Ground readings were taken on all circuits. All circuits were energized and operated.

Q. Indicating Systems.

No change was noted in any indicating system as a result of Test A, except for the HC-HD (wind direction and intensity). The transmitters from this system were missing and the cable to them was parted in two different places on the mainmast.

All indicating systems were checked for operation and ground readings were taken on all cables.

R. I.C. And A.C.O. Switchboards.

No damage was noted to the I.C. or A.C. O. Switchboards as a result of Test A. Switchboards were energized and ground readings were taken on all circuits.

S. F.C. Switchboards.

No change was noted in fire control switchboards as a result of Test A. All fire control switchboards were energized and ground readings were taken on all circuits.

T. Miscellaneous.

No electrical damage was noted to any of the galley equipments as a result of Test A, although deformation of the galley structure caused some mechanical damage. All electrically operated galley equipment was energized and put into operation.

SECTION III

PART C - INSPECTION REPORT

SECTION E - ELECTRONICS

INDEX

A. General Description of Electronics Damage.

1. Immediately after the explosion the effectiveness of electronic equipment aboard this ship was practically zero. This was due to the fact that all radar and all but one radio antenna was carried away or rendered inoperative. The only unit available for communication after the explosion was a SCR-608 radio transceiver whose whip type antenna was bent and burned, but still operative.

2. Major damage resulted primarily in two areas:

(a) Areas above decks where equipment was directly exposed to the blast and heat of the explosion.

(b) Areas inside superstructure compartments. These were Bridge Radio, Radar Aft and Combat Two.

3. The primary cause of damage in each area was:

(a) Blast from bomb and breakage due to falling superstructure components. To a lesser degree damage was caused to several units in this area by shock.

(b) Compartment bulkheads were pushed in by the force of the blast. Bulkheads struck and damaged several units located in this area.

4. The operability of equipment immediately after the explosion, assuming that power was available, was:

(a) Radar: Zero.

(b) Radio: Only SCR-608 available for transmitting. Several radio receivers had shreds of antennas still hanging from the superstructure and were weakly operative.

(c) Sonar: Fathometer operative.

(d) Loran: Antenna down, unit operative.

(e) Remote phone units, TBS remote control units, speaker amplifier units, test equipment, power supplies and spare parts were all essentially in the same condition as prior to Test A.

5. The equipments most severely affected by the blast comprise all the radar, radar interrogation and radar repeating

equipment aboard. A Navy Yard overhaul would definitely be necessary to restore this equipment to operating condition. Although the radio equipment was inoperative after the explosion, local repairs would easily suffice to get a variety of transmitters and receivers back on the air.

B. Fire Control Radar.

The fire-control radar consisted of two Mark Ten and one Mark Three. The Mark III antenna was carried completely away, although the main frame and range units were undamaged. The after Mark X had its transmitter-antenna unit torn off and hurled to the deck, landing some fifty yards from its original position and was damaged beyond repair. The forward Mark X had its antenna demolished and its transmitter torn loose from its cast mounting. Other parts of both Mark X sets were undamaged, Navy Yard facilities would be required to restore all fire control radar sets.

C. Surface Search Radar.

Surface search radar aboard consisted of two SG-Radar Sets. The after SG radar had its antenna attached to the maintopmast. The maintopmast was broken and fell across the deck, demolishing the antenna, wave guide and pedestal. The after SG main frame located in Radar-Aft was pushed in slightly by the bulkhead it mounts against. Damage was minor. The indicator, located in CIC was undamaged. The forward SG radar had its antenna attached to the foretopmast. This topmast was knocked down, and the antenna and pedestal were shattered against part of the superstructure. The antenna reflector was broken and the pedestal damaged. The wave guide was twisted and broken. The main frame, located in Combat Two, was badly damaged due to the fact that the bulkhead it mounts against was pushed in about six inches. The indicator, also in Combat Two, was undamaged. Each of these search radar sets would require Navy Yard overhaul for restoration to service.

D. Air Search Radar.

One SK radar comprised the air search radar aboard. The SK antenna was carried completely away, landing somewhere in the

water. The SK transmitter, located in Combat Two, was undamaged except for the shattering of two tubes which were easily replaced. The SK antenna pedestal was undamaged, although the superstructure component upon which it rests was badly bent and would have to be straightened before a new SK antenna could be installed. The SK console (indicator) located in CIC was undamaged. Navy Yard facilities would be required to restore this set.

E. Radar Repeaters.

Of the nine radar repeaters aboard, six were undamaged. The three repeaters that were damaged were located at Battle Two, Air Defense Forward and Open Bridge. The VD repeater located at Air Defense Forward was severely damaged by heavy falling objects. Its front panel showed signs of burning. Inasmuch as this was the only unit aboard that showed signs of burning it was removed for shipment to NRL. The other two damaged VD repeaters each had V305 an 807 tube, broken and each had the range switch, S203 shattered. This damage was due to shock. All repeaters located in enclosed compartments were undamaged.

F. Radar Counter Measures Equipment.

The radar countermeasures equipment was undamaged, although the SPA-1 Pulse Analyzer fell from its mounting to the deck, a distance of three feet.

G. This ship has no beacon equipment.

H. IFF Equipment.

The IFF equipment aboard was undamaged except for the antennas. The BL antenna was carried away with the SK antenna. One BN antenna was attached to the mainmast and demolished. The forward BN antenna was bent and burned. The after ABK antenna was demolished. The forward ABK antenna was bent and burned. To restore the IFF equipment a complete set of new antennas would be required.

I. Communication Transmitters (Radio).

Communication Transmitters located below decks

were undamaged. The TDQ located in Bridge radio was damaged slightly due to the bulkhead it mounts against being pushed in. It was repaired easily.

J. Communication Receivers.

Communication receivers were undamaged.

K. Communication Antennae (Radio).

Communication antennas were torn down and swept away. This occurred because:

1. Superstructure components to which antennas were attached moved and twisted, breaking antennas.

2. Force of the blast carried antennas away.

There was no way of telling which of the causes was predominant.

L. Radio Transceivers (Combined Transmitters and Receivers).

Four radio transceivers are aboard. One, the TBS located in Bridge Radio, was severely damaged due to being pushed off its mount by the bulkhead which was shoved inward by the explosion. This TBS landed on the deck of the compartment and suffered broken tubes, torn cables and shattered meters. It will require several days work to restore it to condition. The TBS located in Radio 2, the MAN located in CIC, and the SCR-608 located in CIC were undamaged.

M. Sonar Echo Ranging and Listening Equipment.

None aboard. (Sonar ranging).

N. Sonar Echo Sounding Equipment and Altimeters.

A model NM-2 Fathometer located in the Navigators compartment was undamaged. Its components located on the hull were undamaged.

O. Loran Navigation Equipment.

The Loran equipment was undamaged, except that its antenna was swept away.

P. Power Supplies (Motor Generators and Filters).

All power supplies and filters were undamaged.

Q. Television and Teletype Equipment.

None aboard. (Television and Teletype).

R. Test Equipment (Including Frequency Meters).

All test equipment was undamaged.

S. Instrumentation.

None aboard.

T. Telephone Equipment.

All remote telephones and remote control radio telephone boxes were undamaged.

U. Direction Finders (Radio).

None aboard.

V. Spare Parts.

All spare parts, which were carefully packed in their normal stowages prior to the test, were undamaged.

Defense Special Weapons Agency
6801 Telegraph Road
Alexandria, Virginia 22310-3398

TRC

10 April 1997

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
ATTENTION: OMI/Mr. William Bush

SUBJECT: Declassification of Reports

The Defense Special Weapons Agency (formerly Defense Nuclear Agency) Security Office has reviewed and declassified the following reports:

AD-366718	XRD-32-Volume 3
AD-366726	XRD-12-Volume 2
AD-366703	XRD-16-Volume 1
AD-366702	XRD-14-Volume 2
AD-376819L	XRD-17-Volume 2
AD-366704	XRD-18
AD-367451	XRD-19-Volume 1
AD-366705	XRD-20-Volume 2
AD-376028L	XRD-4
AD-366694	XRD-1
AD-473912	XRD-193
AD-473891	XRD-171
AD-473899	XRD-163
AD-473887	XRD-166
AD-473888	XRD-167
AD-473889	XRD-168

AD-366705

TRC 10 April 1997

SUBJECT: Declassification of Reports

AD-B197749	XRD-174
AD-473905	XRD-182
AD-366719	XRD-33 Volume 4
AD-366700	XRD-10
AD-366712	XRD-25 Volume 1
AD-376827L	XRD-75
AD-366756	XRD-73
AD-366757	XRD-74
AD-366755	XRD-72
AD-366754	XRD-71
AD-366710	XRD-23 Volume 1
AD-366711	XRD-24 Volume 2
AD-366753	XRD-70
AD-366749	XRD-66
AD-366701	XRD-11
AD-366745	XRD-62.

All of the cited reports are now **approved for public release; distribution statement "A" applies.**

Ardith Jarrett

ARDITH JARRETT
Chief, Technical Resource Center

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